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Pressure Factor in Mercerization

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FOR the past eighty years much work has been done to determine the effect of temperature, time, and concentration of solution in mercerization, but there has been no study about the effects of pressure, a fourth variable. According to the law of Le Chatelier, which applies to both physical and chemical equilibria, one would expect to increase mercerization effects by increasing the pressure, since sodium hydroxide dissolves in water to give association. For these reasons an attempt has been made to collect information and data indicating what effect pressure would have on the physical properties of the final mercerized product.

When cotton is treated with a cold and sufficiently concentrated solution of sodium hydroxide, then washed free from alkali by water, the following changes are produced: (1) The characteristic twists of the individual cotton fibers disappear and the fibers become more cylindrical; (2) a shrinkage in length occurs; (3) if stretched while being mercerized an increased luster results; (4) the tensile strength increases; (5) the cotton shows an increased reactivity, and (6) an increased adsorptive power results, as shown by increased affinity for dyes and increased capacity for absorbing moisture.

As to the actual nature of the process occurring when cellulose is treated with solutions of sodium hydroxide, opinion is still divided as to whether chemical compounds, such as alcoholates of cellulose and sodium, or solid solutions of sodium hydroxide in cellulose are formed, or whether the process is one of adsorption of sodium hydroxide. Each view has ample evidence in support of it. Clibbens[1] gives a very good summary of all work done in support of these three views to 1923. It will be more or less impossible to explain satisfactorily the shrinkage, increased strength and increased affinity for dyes until it is known whether the process is of a chemical or physical nature; an understanding of the colloidal changes accompanying the process will also be necessary. When these are known it may be possible to select the factors influencing the above factors.

The physical properties of mercerized cotton and the conditions necessary for the acquirement of these new properties have been investigated in the literature. Cotton mercerized loosely loses its flat, ribbon-like form, swells and becomes rounder, the broad, central lumen contracting greatly. The characteristic twists or convolutions also disappear. If the yarn has been mercerized under tension, the individual fibers appear perfectly cylindrical and smooth; the lumen contracts so much that it can barely be distinguished.

Lange[2] has explained the increased luster on cotton yarn mercerized under tension as due to the increased smoothness and more uniform surface of the individual hairs and the resulting increased transparency. This, according to Matthews[3], is due to the fibers swelling transversely and contracting longitudinally, the cross-section becoming circular, so that when the ends of the fiber are fixed a smooth surface is produced. Lange also states that hairs mercerized without tension show many surface folds which appear under the microscope as fine lines, while those mercerized with tension have the form of smooth, cylindrical rods. These views have been corroborated by Adderly[4] and Barrett[5].

A different explanation of the cause of luster has been given by Hubner and Pope[6]. They found that solutions of sodium hydroxide up to 6.5 per cent had no effect on loose hairs; solutions of 7 to 11.5 per cent concentration produced a more or less rapid untwisting of the fiber; a swelling of the fiber was not noticed until the concentration of 15.5 per cent was used, the swelling then occurring after the untwisting had become complete. With 17.5 per cent sodium hydroxide solutions the untwisting and swelling occurred simultaneously, and with higher concentration the swelling preceded untwisting. Since 17.5 per cent sodium hydroxide solution is the lowest concentration which can be used to obtain a luster under ordinary conditions, they draw the conclusion that for a luster to be produced the untwisting of the hair must occur after the swelling has stopped, or at least simultaneously with it.

Harrison[7], however, performed experiments in which cotton hairs were stretched between holders and mercerized so that they could shrink only to the point where they

TABLE I—30° Tw. NaOH at 0° C.

Series A No.	Pressure Lbs.	Time Min.	Stretch	Regain %	STRENGTH Treated oz.	STRENGTH Untreated oz.	STRENGTH Difference oz.	EXTENSIBILITY Treated %	EXTENSIBILITY Untreated %	EXTENSIBILITY Difference %	Shrinkage %
1a	–14.3	2	—	7.2	19.4	20.0	–0.6	25.3	5.8	19.5	19.0
b	–14.3	5	—	7.2	23.6	20.0	3.6	17.6	5.8	11.8	20.0
c	–14.3	10	—	7.9	27.3	20.3	7.0	20.0	6.6	13.4	15.0
2a	–14.3	2	+	7.2	21.6	20.0	1.6	5.7	5.8	–0.1	....
b	–14.3	5	+	7.2	22.1	20.0	2.1	6.0	5.8	0.2	....
c	–14.3	10	+	7.9	24.1	20.3	3.8	6.8	6.6	0.2	....
1a	normal	2	—	7.2	19.5	20.0	–0.5	24.6	5.8	18.8	19.0
b	N	5	—	7.2	24.0	20.0	4.0	19.2	5.8	13.4	15.0
c	N	10	—	7.9	24.1	20.3	3.8	21.1	6.6	14.5	20.0
2a	N	2	+	7.2	23.7	20.0	3.7	6.1	5.8	0.3	....
b	N	5	+	7.2	24.7	20.0	4.7	6.0	5.8	0.2	....
c	N	10	+	7.9	23.6	20.3	3.3	6.4	6.6	–0.2	....
1a	15	2	—	7.2	24.1	20.0	4.1	20.6	5.8	14.8	20.0
b	15	5	—	7.2	25.2	20.0	5.2	21.0	5.8	15.2	20.0
c	15	10	—	7.9	24.6	20.3	4.3	22.6	6.6	16.0	17.0
2a	15	2	+	7.2	20.8	20.0	0.8	6.3	5.8	0.5	....
b	15	5	+	7.2	24.0	20.0	4.0	6.6	5.8	0.8	....
c	15	10	+	7.9	23.7	20.3	3.4	7.0	6.6	0.4	....
1a	30	2	—	7.2	25.0	20.0	5.0	19.2	5.8	13.4	20.0
b	30	5	—	7.2	24.8	20.0	4.8	19.8	5.8	14.0	21.0
c	30	10	—	7.9	24.7	20.3	4.4	20.8	6.6	14.2	18.5
2a	30	2	+	7.2	23.5	20.0	3.5	6.3	5.8	0.5	....
b	30	5	+	7.2	23.7	20.0	3.7	6.2	5.8	0.4	....
c	30	10	+	7.9	23.9	20.3	3.6	7.1	6.6	0.5	....
1a	60	2	—	7.2	23.5	20.0	3.5	19.2	5.8	13.4	18.0
b	60	5	—	7.2	21.7	20.0	1.7	20.6	5.8	14.8	20.0
c	60	10	—	7.9	24.6	20.3	4.3	21.2	6.6	14.6	18.5
2a	60	2	+	7.2	22.5	20.0	2.5	6.7	5.8	0.9	....
b	60	5	+	7.2	22.3	20.0	2.3	6.5	5.8	0.7	....
c	60	10	+	7.9	23.0	20.3	2.7	6.5	6.6	–0.1	....
1a	100	2	—	7.2	24.3	20.0	4.3	16.8	5.8	11.0	15.0
b	100	5	—	7.2	26.0	20.0	6.0	23.9	5.8	18.1	22.5
c	100	10	—	7.9	24.2	20.3	3.9	22.8	6.6	16.2	21.0
1a	100	2	+	7.2	21.4	20.0	1.4	6.1	5.8	0.3	....
b	100	5	+	7.2	23.5	20.0	3.5	6.4	5.8	0.6	....
c	100	10	+	7.9	24.3	20.3	4.0	7.3	6.6	0.7	....

LUSTER

1a: No luster, swollen.
2a: Very little luster.
1b: Same as 1a.
2b: Same as 2a.
1c: Same as 1a.
2c: More lustrous than 2a.

remained straight and yet were under no tension. In this case no luster was produced on subsequent washing. If, however, the fibers were mercerized without removal from the holders and stretched to their original length before washing, a luster was produced. This behavior cannot be explained by Hubner and Pope's theory. Harrison comes to the conclusion that Lange's theory is correct. It seems impossible that the single hairs of a length of yarn being mercerized could be fixed so permanently by the type of tension ordinarily applied as to prevent the formation of spiral ridges as called for by Hubner and Pope's theory. On the whole, Lange's theory seems to be more nearly correct.

It will be observed from a study of the literature upon the action of pressure on sodium hydroxide when used as a mercerizing agent that experimental procedure in regard to the exact pressure to use to obtain the best results is meager. The only mention to the pressure factor in mercerization is given by Coward and Spencer[8], who merely state that Egyptian cotton had been mercerized in a 2 per cent caustic solution for six hours at 125° C., under 20 lbs. pressure, but they drew no conclusions relative to pressure effect.

Equipment and Materials

Winding Equipment — For ease of treatment the cotton was taken from the cones, in which form it was obtained, and put into skeins, each skein weighing 2 grams. A machine was constructed which would take the yarn from the cones and wind it into skeins, under a constant tension so as to obtain the same length each time, each skein containing a length of yarn equivalent to 2 grams, which was determined by a counter to measure the number of turns made. The machine also had a detachable device upon which a skein could be placed and remeasured in order to determine the shrinkage. This machine as finally constructed was similar to the ordinary yarn winder with tension control used by textile testing laboratories.

TABLE II—30° Tw. NaOH at 30°C.

Series B No.	Pressure Lbs.	Time Min.	Stretch	Regain %	STRENGTH Treated oz.	STRENGTH Untreated oz.	STRENGTH Difference oz.	EXTENSIBILITY Treated %	EXTENSIBILITY Untreated %	EXTENSIBILITY Difference %	Shrinkage %
1a	−14.3	2	—	6.6	23.1	21.1	2.0	12.8	6.4	6.4	12.5
b	−14.3	5	—	6.6	24.2	21.1	3.1	18.2	6.4	11.8	19.0
c	−14.3	10	—	8.0	26.0	20.6	5.4	14.9	6.4	8.5	15.0
2a	−14.3	2	+	6.6	21.5	21.1	0.4	7.1	6.4	0.7	....
b	−14.3	5	+	6.6	23.7	21.1	2.6	6.4	6.4	0.0	....
c	−14.3	10	+	8.0	22.8	20.6	2.2	6.3	6.4	−0.1	....
1a	normal	2	—	6.6	25.2	21.1	4.1	16.4	6.4	10.0	15.5
b	N	5	—	6.6	26.1	21.1	5.0	18.4	6.4	12.0	15.5
c	N	10	—	8.0	27.6	20.6	7.0	18.7	6.4	12.3	17.5
2a	N	2	+	6.6	22.4	21.1	1.3	6.3	6.4	−0.1	....
b	N	5	+	6.6	22.3	21.1	1.2	6.1	6.4	−0.3	....
c	N	10	+	8.0	22.7	20.6	2.1	6.0	6.4	−0.4	....
1a	15	2	—	6.6	24.5	21.1	3.4	13.8	6.4	7.4	16.5
b	15	5	—	6.6	24.1	21.1	3.0	15.6	6.4	9.2	11.5
c	15	10	—	8.0	24.8	20.6	4.2	16.0	6.4	9.6	16.0
2a	15	2	+	6.6	22.1	21.1	1.0	6.2	6.4	−0.2	....
b	15	5	+	6.6	24.2	21.1	3.1	6.5	6.4	0.1	....
c	15	10	+	8.0	22.5	20.6	1.9	6.1	6.4	−0.3	....
1a	30	2	—	6.6	26.1	21.1	5.0	17.5	6.4	11.1	20.0
b	30	5	—	6.6	25.2	21.1	4.1	17.8	6.4	11.4	15.0
c	30	10	—	8.0	24.4	20.6	3.8	15.1	6.4	8.7	15.0
2a	30	2	+	6.6	21.9	21.1	0.8	6.5	6.4	0.1	....
b	30	5	+	6.6	22.4	21.1	1.3	5.8	6.4	−0.6	....
c	30	10	+	8.0	24.2	20.6	3.6	6.0	6.4	−0.4	....
1a	60	2	—	6.6	23.7	21.1	2.6	15.8	6.4	9.4	14.0
b	60	5	—	6.6	24.9	21.1	3.8	16.9	6.4	10.5	19.0
c	60	10	—	8.0	26.9	20.6	6.3	17.7	6.4	11.3	16.5
2a	60	2	+	6.6	22.0	21.1	0.9	6.6	6.4	0.2	....
b	60	5	+	6.6	23.8	21.1	2.7	5.8	6.4	−0.6	....
c	60	10	+	8.0	24.0	20.6	3.4	6.3	6.4	−0.1	....
1a	100	2	—	6.6	26.7	21.1	5.6	15.7	6.4	9.3	15.0
b	100	5	—	6.6	24.8	21.1	3.7	16.2	6.4	9.8	15.0
c	100	10	—	8.0	26.3	20.6	5.7	18.3	6.4	11.9	19.5
1a	100	2	+	6.6	23.0	21.1	1.9	6.1	6.4	−0.3	....
b	100	5	+	6.6	24.1	21.1	3.0	6.2	6.4	−0.2	....
c	100	10	+	8.0	23.4	20.6	2.8	6.0	6.4	−0.4	....

LUSTER

1a: No luster, less swollen than Series A 1a.
2a: More luster than Series A 2a.
1b: Less swollen than 1a.
2b: Same as 2a.
1c: Less swollen than 1b.
2c: Same as 2a.

The forms upon which the yarn was wound consisted of flat sheets of 0.02-inch Monel metal, 2¾ by 7½ inches, with 0.0185-inch diameter perforations, 144 per square inch, bent in such a manner that one turn of yarn wound on the form measured 10 inches (with the later-described slips in place). To enable the skeins wound upon these forms to be slipped off easily and without damage, slips of thin sheet tantalum 2¾ by 1½ inches were bent to the shape of the ends so that they could be slipped on and off easily. These slips then come between the yarn and the metal form.

These forms were made detachable so that they could be immersed in the caustic without removing the yarn, serving as a means of keeping the yarn under tension while immersed. This was accomplished by making a slot in the shaft of the winder carrying the Monel metal form so that this form could be slipped into the slot and bolted to the shaft through holes drilled at right angles to the slot and corresponding in position to similar holes drilled in the metal form.

Tensile Strength Testing Equipment—The tensile strength and extensibility were determined upon a Suter "Single Strand Strength and Elasticity Tester," which indicates breaking strengths of 0 to 2 pounds on one scale and 0 to 15 pounds on the other. However, it was only necessary to use the 0 to 2 pound scale in this work.

Pressure Autoclave—Pressure was maintained in a pressure autoclave which was equipped with a pressure gauge indicating 0 to 100 pounds and from 0 to 15 pounds vacuum. Compressed air was transferred from a large compressed-air tank for convenience to a small cylinder 2 feet long by 6 inches in diameter. The large tank delivered 150 pounds pressure to the small cylinder, which was later connected through a ⅜-inch iron pipe and valve to the autoclave. Vacuum was produced by an aspirator which was calibrated with a closed-end mercury manometer. The nearest approach to vacuum was—14.3 pounds pressure with a variation of 0.2 pound. This pressure was maintained in the autoclave at all temperatures

TABLE III—30° Tw. NaOH at 50° C.

Series C No.	Pressure Lbs.	Time Min.	Stretch	Regain %	STRENGTH Treated oz.	STRENGTH Untreated oz.	STRENGTH Difference oz.	EXTENSIBILITY Treated %	EXTENSIBILITY Untreated %	EXTENSIBILITY Difference %	Shrinkage %
1a	−14.3	2	—	7.2	22.7	20.0	2.7	12.1	5.8	6.3	13.5
b	−14.3	5	—	6.6	23.0	20.8	2.2	11.4	6.4	5.0	14.0
c	−14.3	10	—	6.6	23.3	20.8	2.5	12.5	6.4	6.1	10.0
2a	−14.3	2	+	7.2	22.7	20.8	2.7	6.7	5.8	0.9	....
b	−14.3	5	+	6.6	22.0	20.8	1.2	6.9	6.4	0.5	....
c	−14.3	10	+	6.6	22.6	20.8	1.8	6.5	6.4	0.1	....
1a	normal	2	—	7.2	20.4	20.0	0.4	9.5	5.8	3.7	5.5
b	N	5	—	6.6	21.5	20.8	0.7	9.3	6.4	2.9	17.0
c	N	10	—	6.6	20.9	20.8	0.1	10.0	6.4	3.6	11.0
2a	N	2	+	7.2	20.1	20.0	0.1	7.3	5.8	1.5	....
b	N	5	+	6.6	20.7	20.8	−0.1	7.6	6.4	1.2	....
c	N	10	+	6.6	21.2	20.8	0.4	6.9	6.4	0.5	....
1a	15	2	—	7.2	22.4	20.0	2.4	11.1	5.8	5.3	5.0
b	15	5	—	6.6	24.5	20.8	3.7	13.2	6.4	6.8	11.0
c	15	10	—	6.6	21.8	20.8	1.0	11.2	6.4	4.8	10.5
2a	15	2	+	7.2	21.8	20.0	1.8	6.9	5.8	1.1	....
b	15	5	+	6.6	22.5	20.8	1.7	6.7	6.4	0.3	....
c	15	10	+	6.6	22.8	20.8	2.0	6.5	6.4	0.1	....
1a	30	2	—	7.2	20.5	20.0	0.5	9.6	5.8	3.8	10.0
b	30	5	—	6.6	24.2	20.8	3.4	14.5	6.4	8.1	11.0
c	30	10	—	6.6	24.5	20.8	3.7	12.4	6.4	6.0	13.5
2a	30	2	+	7.2	20.3	20.0	0.3	7.1	5.8	1.3	....
b	30	5	+	6.6	22.0	20.8	1.2	6.9	6.4	0.5	....
c	30	10	+	6.6	21.3	20.8	0.5	6.0	6.4	−0.4	....
1a	60	2	—	7.2	24.0	20.0	4.0	9.9	5.8	4.1	8.0
b	60	5	—	6.6	22.4	20.8	1.6	10.9	6.4	4.5	11.0
c	60	10	—	6.6	24.0	20.8	3.2	12.2	6.4	5.8	14.0
2a	60	2	+	7.2	20.7	20.0	0.7	7.4	5.8	1.6	....
b	60	5	+	6.6	21.8	20.8	1.0	6.6	6.4	0.2	....
c	60	10	+	6.6	21.4	20.8	0.6	6.1	6.4	−0.3	....
1a	100	2	—	7.2	22.1	20.0	2.1	8.9	5.8	3.1	10.5
b	100	5	—	6.6	22.0	20.8	1.2	10.1	6.4	3.7	11.5
c	100	10	—	6.6	24.5	20.8	3.7	12.9	6.4	6.5	14.0
1a	100	2	+	7.2	20.3	20.0	0.3	7.4	5.8	1.6	....
b	100	5	+	6.6	22.5	20.8	1.7	7.4	6.4	1.0	....
c	100	10	+	6.6	22.5	20.8	1.7	6.3	6.4	−0.1	....

LUSTER

1a: Same as Series B 1a.
2a: More lustrous than Series B 2a.
1b: Less swollen than 1a.
2b: Same as 2a.
1c: Less swollen than 1b.
2c: Same as 2a.

except at 80° C., at which temperature pressure no lower than—14.0 pounds could be maintained due to boiling of the mercerizing solution at that temperature.

Auxiliary Equipment — The caustic strength was measured by means of specific gravity determinations made with a set of hydrometers. The error in measuring the caustic concentration by this method was plus or minus 0.2 per cent.

For caustic bath vessels 600-cc. beakers placed in the autoclave were used. Skeins were suspended in the caustic from U-bent glass rods. It was also found best to use much smaller, similarly shaped glass rods suspended from the lower end of the keins to act as small weights to keep the skeins in a vertical position and prevent tangling.

The relative humidity necessary in making tensile strength determinations was found by using an ordinary sling-type psychrometer.

Temperature Bath—An approximate constant temperature was maintained in a large tank of water. The temperature was maintained at zero with large amounts of cracked ice and water. All other temperatures above zero were maintained by a steam coil in the bath.

Materials — It was extremely difficult to obtain a cotton yarn which would give a uniform tensile strength throughout its length. One yarn tested and rejected varied in tensile strength from 16.2 to 20.8 ounces, a variation of 4.6 ounces. The best which could be obtained was unbleached 33/2, combed peeler yarn, made by the Wiscasset Mills Company, Albemarle, N. C. On the average, as above, this yarn varied from 17.3 to 19.9 ounces in tensile strength, a variation of 2.6 ounces.

The sodium hydroxide flake and hydrochloric acid used were "Baker's C. P. Analyzed." The Monopole oil used was furnished by Jacques Wolf & Co., Passaic, N. J. It was used for wetting out the cotton before treatment. For determining the affinity for dyes, Chlorantine Red 6BL, made by the Gesellschaft für chemische Industrie of Basle, was used. This was furnished by the Viscose Company, Marcus Hook, Pa.

TABLE IV—30° Tw. NaOH at 80° C.

Series D No.	Pressure Lbs.	Time Min.	Stretch	Regain %	STRENGTH Treated oz.	STRENGTH Untreated oz.	STRENGTH Difference oz.	EXTENSIBILITY Treated %	EXTENSIBILITY Untreated %	EXTENSIBILITY Difference %	Shrinkage %
1a	–14.3	2	—	7.9	22.1	20.3	1.8	9.2	6.6	2.6	7.5
b	–14.3	5	—	7.4	21.5	20.1	1.4	9.3	6.2	3.1	6.0
c	–14.3	10	—	7.4	21.1	20.1	1.0	10.0	6.2	3.8	9.5
2a	–14.3	2	+	7.9	22.0	20.3	1.7	7.7	6.6	1.1	....
b	–14.3	5	+	7.4	21.4	20.1	1.3	6.5	6.2	0.3	....
c	–14.3	10	+	7.4	21.1	20.1	1.0	6.0	6.2	–0.2	....
1a	normal	2	—	7.9	20.5	20.3	0.2	9.6	6.6	3.0	0.0
b	N	5	—	7.4	20.1	20.1	0.0	8.8	6.2	2.6	4.0
c	N	10	—	7.4	21.8	20.1	1.7	7.3	6.2	1.1	14.0
2a	N	2	+	7.9	21.2	20.3	0.9	7.9	6.6	1.3	....
b	N	5	+	7.4	20.7	20.1	0.6	6.7	6.2	0.5	....
c	N	10	+	7.4	20.5	20.1	0.4	6.3	6.2	0.1	....
1a	15	2	—	7.9	22.2	20.3	1.9	9.5	6.6	2.9	2.5
b	15	5	—	7.4	20.3	20.1	0.2	8.0	6.2	1.8	3.5
c	15	10	—	7.4	20.6	20.1	0.5	7.8	6.2	1.6	14.0
2a	15	2	+	7.9	21.7	20.3	1.4	8.0	6.6	1.4	....
b	15	5	+	7.4	19.8	20.1	–0.3	7.0	6.2	0.8	....
c	15	10	+	7.4	20.6	20.1	0.5	6.1	6.2	–0.1	....
1a	30	2	—	7.9	20.9	20.3	0.6	10.2	6.6	3.6	5.5
b	30	5	—	7.4	21.8	20.1	1.7	9.6	6.2	3.4	9.5
c	30	10	—	7.4	20.1	20.1	0.0	8.0	6.2	1.8	3.5
2a	30	2	+	7.9	22.7	20.3	2.4	8.0	6.6	1.4	....
b	30	5	+	7.4	20.9	20.1	0.8	6.5	6.2	0.3	....
c	30	10	+	7.4	21.7	20.1	1.6	6.7	6.2	0.5	....
1a	60	2	—	7.9	21.2	20.3	0.9	10.3	6.6	3.7	5.0
b	60	5	—	7.4	21.0	20.1	0.9	9.6	6.2	3.4	11.5
c	60	10	—	7.4	21.0	20.1	0.9	9.0	6.2	2.8	4.5
2a	60	2	+	7.9	21.4	20.3	1.1	8.0	6.6	1.4	....
b	60	5	+	7.4	22.3	20.1	2.2	6.8	6.2	0.6	....
c	60	10	+	7.4	21.0	20.1	0.9	7.0	6.2	0.8	....
1a	100	2	—	7.9	21.6	20.3	1.3	10.1	6.6	3.5	4.0
b	100	5	—	7.4	21.3	20.1	1.2	8.5	6.2	2.3	7.0
c	100	10	—	7.4	20.0	20.1	–0.1	6.7	6.2	0.5	8.5
1a	100	2	+	7.9	22.7	20.3	2.4	7.5	6.6	0.9	....
b	100	5	+	7.4	20.1	20.1	0.0	6.6	6.2	0.4	....
c	100	10	+	7.4	21.6	20.1	1.5	6.7	6.2	0.5	....

LUSTER

1a: Little swollen, very white.
2a: Less lustrous than Series A 2a.
1b: Same as 1a.
2b: Same as 2a.
1c: Same as 1a.
2c: Same as 1a; difficult to distinguish from 1c.

Procedure

The effect of pressure upon the cotton was measured by the change in each of the following properties of the cotton yarn: Luster, appearance to the eye, tensile strength, extensibility, affinity for dyes, and shrinkage in length. Knowing the change in these properties, graphs can be plotted showing the effect of each of the variable factors, pressure, temperature, time, and concentration in the treatment, the other factors remaining constant, upon each of the properties tested of the cotton. Since, however, it is exceedingly difficult to measure the change in all the above properties exactly and to maintain the variable factors at the same value each time without an unreasonable expenditure of time, the data found should be considered relative, indicating the tendencies toward change caused by the treatment.

Mercerization

Two-gram skeins of the yarn were prepared by winding 200 turns on the winding machine. Each skein was wet out with a 10 per cent solution of Monopole oil in water and thoroughly rinsed from the sample just before entering into the mercerizing solution. The sample was then immersed in a bath containing 600 cc. of sodium hydroxide solution of specified strength contained in a 600-cc. beaker inside the autoclave, which was immediately closed and lowered into the temperature bath. It was quickly connected to the pressure cylinder and the desired pressure adjusted with the outlet valve for the specified time. All operations required approximately 20 seconds time. At the end of the specified time period the pressure was released, the cylinder disconnected, and the autoclave removed from the bath. Samples were quickly removed and immediately washed in cold water until neutral to phenolphthalein, then soured off in a 1 per cent solution of hydrochloric acid and again washed with water until neutral to methyl orange. All samples were removed from the forms and hung loose on glass rods to dry in the air.

TABLE V—50° Tw. NaOH at 0° C.

Series A No.	Pressure Lbs.	Time Min.	Stretch	Regain %	STRENGTH Treated oz.	STRENGTH Untreated oz.	STRENGTH Difference oz.	EXTENSIBILITY Treated %	EXTENSIBILITY Untreated %	EXTENSIBILITY Difference %	Shrinkage %
1a	−14.3	2	—	8.0	24.5	21.3	3.2	17.5	4.0	13.5	17.0
b	−14.3	5	—	6.4	24.5	20.3	4.2	15.1	4.4	10.7	17.0
c	−14.3	10	—	6.4	26.6	20.3	6.3	20.5	4.4	16.1	23.5
2a	−14.3	2	+	8.0	22.9	21.3	1.6	5.3	4.0	1.3	....
b	−14.3	5	+	9.3	23.9	21.4	2.5	6.7	6.6	0.1	....
c	−14.3	10	+	6.4	23.4	20.3	3.1	5.3	4.4	0.9	....
1a	normal	2	—	8.0	26.0	21.3	4.7	16.0	4.0	12.0	19.5
b	N	5	—	6.4	25.8	20.3	5.5	17.6	4.4	13.2	20.0
c	N	10	—	6.4	26.0	20.3	5.7	20.2	4.4	15.8	21.5
2a	N	2	+	8.0	22.9	21.3	1.6	5.3	4.0	1.3	....
b	N	5	+	6.4	23.3	20.3	3.0	5.0	4.4	0.6	....
c	N	10	+	6.4	25.1	20.3	4.8	5.4	4.4	1.0	....
1a	15	2	—	8.0	24.7	21.3	3.4	16.9	4.0	12.9	22.0
b	15	5	—	6.4	24.2	20.3	3.9	20.1	4.4	15.7	20.0
c	15	10	—	6.4	26.0	20.3	5.7	20.6	4.4	16.2	26.5
2a	15	2	+	8.0	22.2	21.3	0.9	5.2	4.0	1.2	....
b	15	5	+	6.4	24.2	20.3	3.9	5.5	4.4	1.1	....
c	15	10	+	6.4	26.5	20.3	6.2	5.4	4.4	1.0	....
1a	30	2	—	8.0	25.4	21.3	4.1	18.3	4.0	14.3	21.5
b	30	5	—	6.4	25.7	20.3	5.4	19.4	4.4	15.0	24.0
c	30	10	—	6.4	27.4	20.3	7.1	19.1	4.4	14.7	23.0
2a	30	2	+	9.3	23.3	21.4	1.9	5.7	6.6	−0.9	....
b	30	5	+	6.4	23.3	20.3	3.0	4.9	4.4	0.5	....
c	30	10	+	6.4	25.9	20.3	5.6	5.6	4.4	1.2	....
1a	60	2	—	8.0	26.1	21.3	5.8	18.3	4.0	14.3	18.5
b	60	5	—	6.4	25.0	20.3	4.7	15.6	4.4	11.2	16.5
c	60	10	—	6.4	26.5	20.3	6.2	20.4	4.4	16.0	25.0
2a	60	2	+	9.3	25.0	21.4	3.6	6.2	6.6	−0.4	....
b	60	5	+	6.4	24.4	20.3	4.1	5.7	4.4	1.3	....
c	60	10	+	6.4	25.1	20.3	4.8	5.1	4.4	0.7	....
1a	100	2	—	8.0	26.7	21.3	5.4	17.0	4.0	13.0	20.0
b	100	5	—	6.4	26.0	20.3	5.7	18.7	4.4	14.3	22.0
c	100	10	—	6.4	26.8	20.3	6.5	19.9	4.4	15.5	21.0
1a	100	2	+	9.3	23.9	21.4	2.5	5.9	6.6	−0.7	....
b	100	5	+	6.4	24.5	20.3	4.2	5.6	4.4	1.2	....
c	100	10	+	6.4	25.8	20.3	5.5	5.2	4.4	0.8	....

LUSTER

1a: Very swollen.
2a: Luster ⅔ that of rayon.
1b: Same as 1a.
2b: Same as 2a.
1c: Same as 1a.
2c: Same as 2a.

Testing

Shrinkage—The skeins were then rewound on the winding machine in order to determine the per cent of shrinkage. Knowing the loss in number of turns, the per cent shrinkage is found from the simple ratio of the loss in number of turns to the original number.

Tensile Strength and Extensibility—One gram or one-half of each skein was then reeled from the skein on the winding machine and set aside with its labeling tag to be used later in the dyeing test. An average value of ten successive tests on the tensile strength and extensibility were made on the remaining half of the skein and taken as the true value of the sample at the per cent regain of cotton at the time of testing. The regain was taken from Hartshorne's table[9] by determining the relative humidity of the atmosphere in the testing room at the time of making the test.

Tensile strength and extensibility as determined by the testing machine must be compared with those of untreated yarn having the same regain and from which the loss in strength due to washing with oil, water, and hydrochloric acid alone has been subtracted and from which the gain in extensibility due to this treatment has been subtracted in order to obtain the true values caused by the caustic treatment. The difference between calculated values and those obtained on the testing machine with the treated sample gives the true change caused by the caustic treatment.

Luster and Appearance—Change of luster was determined by appearance to the eye, comparing the samples with untreated yarn and rayon.

Dyeing and Grading — The remaining half, one gram, of the skeins was wet out with Monopole oil, rinsed, and dyed in a 0.2 per cent Chlorantine Red 6BL and 5 per cent sodium sulfate dye bath at 45° C. to 85° C. for thirty minutes. Standard dye and sodium sulfate solutions were made up and a given volume containing the correct weight was pipetted into the dye beaker and diluted to 55 cc. Samples were placed in the bath at 45° C. which was slowly heated to 85° C. and allowed to cool

TABLE VI—50° Tw. NaOH at 30° C.

Series B No.	Pressure Lbs.	Time Min.	Stretch	STRENGTH Regain %	Treated oz.	Untreated oz.	Difference oz.	EXTENSIBILITY Treated %	Untreated %	Difference %	Shrinkage %
1a	–14.3	2	—	7.2	23.5	19.5	4.0	8.8	4.0	4.8	15.0
b	–14.3	5	—	9.3	25.5	21.4	4.1	17.9	6.6	11.3	21.5
c	–14.3	10	—	7.4	26.0	21.6	4.4	17.5	5.0	12.5	20.0
2a	–14.3	2	+	7.2	22.3	19.5	2.8	5.1	4.0	1.1	....
b	–14.3	5	+	9.3	25.4	21.4	4.0	5.9	6.6	–0.7	....
c	–14.3	10	+	7.4	24.5	21.6	2.9	5.8	5.0	0.8	....
1a	normal	2	—	7.2	23.7	19.5	4.2	14.8	4.0	10.8	18.5
b	N	5	—	9.3	27.0	21.4	5.6	18.3	6.6	11.7	22.5
c	N	10	—	7.4	27.3	21.6	5.7	21.1	5.0	16.1	19.0
2a	N	2	+	7.2	23.9	19.5	4.4	4.9	4.0	0.9	....
b	N	5	+	9.3	24.9	21.4	3.5	5.9	6.6	–0.7	....
c	N	10	+	7.4	26.3	21.6	4.7	6.2	5.0	1.2	....
1a	15	2	—	7.2	24.5	19.5	5.0	17.7	4.0	13.7	17.0
b	15	5	—	9.3	25.8	21.4	4.4	18.0	6.6	11.4	21.0
c	15	10	—	7.4	24.0	21.6	2.4	17.7	5.0	12.7	17.0
2a	15	2	+	7.2	23.2	19.5	3.7	4.5	4.0	0.5	....
b	15	5	+	9.3	23.0	21.4	1.6	5.8	6.6	–0.8	....
c	15	10	+	7.4	24.5	21.6	2.9	5.6	5.0	0.6	....
1a	30	2	—	7.2	25.7	19.5	6.2	16.4	4.0	12.4	22.5
b	30	5	—	9.3	25.4	21.4	4.0	17.6	6.6	11.0	20.0
c	30	10	—	7.4	24.5	21.6	2.9	20.0	5.0	15.0	19.0
2a	30	2	+	7.2	22.4	19.5	2.9	5.0	4.0	1.0	....
b	30	5	+	9.3	24.2	21.4	2.8	5.9	6.6	–0.7	....
c	30	10	+	7.4	24.6	21.6	3.0	5.6	5.0	0.6	....
1a	60	2	—	7.2	24.4	19.5	4.9	16.9	4.0	12.9	20.0
b	60	5	—	9.3	25.6	21.4	4.2	18.6	6.6	12.0	22.0
c	60	10	—	7.4	26.2	21.6	4.6	21.0	5.0	16.0	21.5
2a	60	2	+	7.2	26.2	19.5	2.7	5.1	4.0	1.1	....
b	60	5	+	9.3	24.6	21.4	3.2	6.1	6.6	–0.5	....
c	60	10	+	7.4	24.8	21.6	3.2	5.6	5.0	0.6	....
1a	100	2	—	7.2	25.4	19.5	5.9	14.6	4.0	10.6	15.5
b	100	5	—	9.3	25.3	21.4	3.9	18.4	6.6	11.8	21.5
c	100	10	—	7.4	25.1	21.6	3.5	17.4	5.0	12.4	21.0
1a	100	2	+	7.2	24.1	19.5	2.7	6.0	4.0	2.0	....
b	100	5	+	9.3	25.4	21.4	4.0	6.4	6.6	–0.2	....
c	100	10	+	7.4	23.6	21.6	2.0	5.6	5.0	0.6	....

LUSTER

1a: Same as Series A 1a.
2a: Same as Series A 2a.
1b: Same as 1a.
2b: Same as 2a.
1c: Same as 1a.
2c: Same as 2a.

in the bath thirty minutes from the time of entry. The dye bath was then poured off, the sample rinsed twice with clear water, and dried loose in the air on glass rods.

With each set dyed a blank was dyed at the same time for comparison. Shade comparisons were made by the eye and with Ridgway's color chart[10]. X indicates the blank and the other three distinguishable increasing depths of shade are indicated by A, B, and C. +A, +B, and +C represent shades darker than A, B, and C, but fixing themselves between A and B, B and C, etc. These colors compared with Ridgway's color standards are shown in Table No. 1 A.

TABLE NO. 1 A

COLOR SYSTEM USED COMPARED WITH RIDGWAY'S COLOR STANDARD

System Color No.	Ridgway's Color No.	Ridgway's Color Name
X	71'd	Thulite Pink
A	71'd	Thulite Pink
+A*	71'b	Spinel Pink
B	71 d	Deep Rose Pink
+B	71 b	Rose Color
C	71'b	Spinel Pink
+C†	71 b	Tyrian Pink

*Closely resembles Thulite Pink but a shade darker, however, not as dark a Spinel Pink.

†Closely resembles Rose Color but a shade darker, however, not as dark as Tyrian Pink.

EXPERIMENTAL

The investigation undertaken consisted essentially in determining the effect of each of the following variable factors: pressure, temperature, time, and concentration of solution upon the cotton yarn by the change in each of the following properties: tensile strength, extensibility, luster, appearance to the eye, shrinkage in length, and dye affinity.

Runs were made using sodium hydroxide concentrations of 30°, 50°, and 70° Tw. For each concentration

TABLE VII—50° Tw. NaOH at 50° C.

Series C No.	Pressure Lbs.	Time Min.	Stretch	Regain %	STRENGTH Treated oz.	STRENGTH Untreated oz.	STRENGTH Difference oz.	EXTENSIBILITY Treated %	EXTENSIBILITY Untreated %	EXTENSIBILITY Difference %	Shrinkage %
1a	–14.3	2	—	7.9	23.6	21.3	2.3	14.1	4.0	10.1	13.5
b	–14.3	5	—	9.2	25.4	21.4	4.0	17.3	6.6	10.7	20.0
c	–14.3	10	—	7.4	26.7	21.6	5.1	14.4	5.0	9.4	11.5
2a	–14.3	2	+	9.2	24.4	21.4	3.0	6.4	6.6	–0.2	....
b	–14.3	5	+	9.2	24.3	21.4	2.9	6.0	6.6	–0.6	....
c	–14.3	10	+	7.4	24.8	21.6	3.2	5.4	5.0	0.4	....
1a	normal	2	—	7.9	23.9	21.3	2.6	15.6	4.0	11.6	18.0
b	N	5	—	9.2	25.0	21.4	3.6	16.7	6.6	11.1	21.0
c	N	10	—	7.4	26.8	21.6	5.2	19.3	5.0	14.3	21.0
2a	N	2	+	7.9	24.7	21.3	3.4	5.2	4.0	1.2	....
b	N	5	+	9.2	24.4	21.4	3.0	5.9	6.6	–0.7	....
c	N	10	+	7.4	24.4	21.6	2.8	5.1	5.0	0.1	....
1a	15	2	—	7.9	24.5	21.3	3.2	16.0	4.0	12.0	17.5
b	15	5	—	9.2	26.1	21.4	4.7	11.5	6.6	4.9	21.0
c	15	10	—	7.4	24.9	21.6	3.3	18.6	5.0	13.6	16.5
2a	15	2	+	9.2	25.3	21.4	3.9	5.9	6.6	–0.7	....
b	15	5	+	9.2	25.1	21.4	3.7	6.0	6.6	–0.6	....
c	15	10	+	7.4	23.9	21.6	2.3	5.5	5.0	0.5	....
1a	30	2	—	7.9	25.6	21.3	4.3	16.1	4.0	12.1	20.0
b	30	5	—	9.2	24.6	21.4	3.2	16.3	6.6	9.7	20.0
c	30	10	—	7.4	24.2	21.6	2.6	18.7	5.0	13.7	13.0
2a	30	2	+	7.9	22.9	21.3	1.6	5.3	4.0	1.3	....
b	30	5	+	9.2	25.0	21.4	3.6	6.1	6.6	–0.5	....
c	30	10	+	7.4	25.7	21.6	4.1	5.4	5.0	0.4	....
1a	60	2	—	7.9	24.8	21.3	3.5	11.1	4.0	7.1	17.5
b	60	5	—	9.2	26.1	21.4	4.7	16.9	6.6	10.3	21.5
c	60	10	—	7.4	25.9	21.6	4.3	16.7	5.0	11.7	12.0
2a	60	2	+	7.9	25.9	21.3	3.6	5.2	4.0	1.2	....
b	60	5	+	9.2	24.4	21.4	3.0	6.1	6.6	–0.5	....
c	60	10	+	7.4	24.6	21.6	3.0	5.6	5.0	0.6	....
1a	100	2	—	7.9	26.6	21.3	5.3	16.2	4.0	12.2	16.5
b	100	5	—	9.2	26.0	21.4	4.6	17.3	6.6	10.7	21.0
c	100	10	—	7.4	24.8	21.6	3.2	19.2	5.0	14.2	12.0
1a	100	2	+	7.9	24.3	21.3	3.0	5.3	4.0	1.3	....
b	100	5	+	9.2	24.4	21.4	3.0	6.4	6.6	–0.2	....
c	100	10	+	7.4	25.2	21.6	3.6	5.9	5.0	0.9	....

LUSTER

1a: Same as Series A 1a.
2a: Same as Series A 2a.
1b: Same as 1a.
2b: Same as 2a.
1c: Same as 1a.
2c: Same as 2a.

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runs were made at temperatures of 0°, 30°, 50°, and 80° C. For each concentration and each temperature runs were made under pressures of—14.3, normal, 15, 30, 60, and 100 pounds per square inch. At each pressure, temperature, and strength of solution runs were made with and without tension on the yarn, varying the time of immersion 2, 5, and 10 minutes.

Experimental Data

The following is a brief explanation of the data obtained and the contents of tables and graphs:

Tables No. 1, 2, 3, 4 contain data on the tensile strength, extensibility, and shrinkage of the yarn treated with 30° Tw. caustic soda at temperatures 0°, 30°, 50°, and 80° C., respectively, using pressures of—14.3, normal, 15, 30, 60, and 100 pounds per square inch. Graphs No. 1, 2, 3, 4 show the effects of the treatment of the yarn under the above controlled conditions.

Tables No. 5, 6, 7, 8 contain data on the tensile strength, extensibility, and shrinkage of the yarn treated with 50° Tw. caustic soda at temperatures 0°, 30°, 50°, and 80° C., respectively, using pressures of—14.3, normal, 15, 30, 60, 100 pounds per square inch. Graphs No. 5, 6, 7, 8 show the effects of treatment of the yarn under the above controlled conditions.

Tables No. 9, 10, 11, 12 contain data on the tensile strength, extensibility, and shrinkage of the yarn treated with 70° Tw. caustic soda at temperatures 0°, 30°, 50°, and 80° C. respectively, using pressures of—14.3, normal, 15, 30, 60, and 100 pounds per square inch. Graphs No. 9, 10, 11, 12 show the effects of treatment of the yarn under the above controlled conditions.

Discussion of Results

Effects of Time of Immersion on Tensile Strength—The time of immersion to obtain a maximum tensile strength is a function of the strength of solution and the temperature used. Generally speaking, with an increase in strength of solution and an increase in tem-

TABLE VIII—50° Tw. NaOH at 80°C.

Series D No.	Pressure Lbs.	Time Min.	Stretch	Regain %	STRENGTH Treated oz.	STRENGTH Untreated oz.	STRENGTH Difference oz.	EXTENSIBILITY Treated %	EXTENSIBILITY Untreated %	EXTENSIBILITY Difference %	Shrinkage %
1a	–14.3	2	—	7.9	22.7	21.3	1.4	11.6	4.9	6.7	10.0
b	–14.3	5	—	7.9	24.8	21.6	3.2	11.3	5.0	6.3	9.0
c	–14.3	10	—	7.4	23.4	21.6	1.8	11.1	5.0	6.1	8.0
2a	–14.3	2	+	7.9	22.6	21.3	1.3	4.9	4.9	0.0	....
b	–14.3	5	+	7.9	23.2	21.6	1.6	5.7	5.0	0.7	....
c	–14.3	10	+	7.4	21.4	21.6	–0.2	5.6	5.0	0.6	....
1a	normal	2	—	7.9	23.7	21.3	2.4	13.4	4.9	8.5	13.5
b	N	5	—	7.9	26.3	21.6	4.7	15.1	5.0	10.1	13.5
c	N	10	—	7.4	27.4	21.6	5.8	16.2	5.0	11.2	17.0
2a	N	2	+	7.9	20.7	21.3	–0.6	5.4	4.9	0.5	....
b	N	5	+	7.9	24.6	21.6	3.0	5.6	5.0	0.6	....
c	N	10	+	7.4	25.2	21.6	3.6	5.1	5.0	0.1	....
1a	15	2	—	7.9	24.0	21.3	2.7	13.6	4.9	8.7	12.5
b	15	5	—	7.9	24.7	21.6	3.1	13.4	5.0	8.4	11.0
c	15	10	—	7.4	27.6	21.6	6.0	15.7	5.0	10.7	16.0
2a	15	2	+	7.9	23.3	21.3	2.0	5.5	4.9	0.6	....
b	15	5	+	7.9	24.6	21.6	3.0	5.5	5.0	0.5	....
c	15	10	+	7.4	25.4	21.6	3.8	5.2	5.0	0.2	....
1a	30	2	—	7.9	23.6	21.3	2.3	14.6	4.9	9.7	13.5
b	30	5	—	7.9	23.5	21.6	1.9	14.3	5.0	9.3	13.5
c	30	10	—	7.4	26.2	21.6	4.6	16.2	5.0	11.2	17.0
2a	30	2	+	7.9	22.6	21.3	1.3	5.3	4.9	0.4	....
b	30	5	+	7.9	23.8	21.6	2.2	5.7	5.0	0.7	....
c	30	10	+	7.4	26.1	21.6	4.5	5.0	5.0	0.0	....
1a	60	2	—	7.9	25.8	19.3	6.5	15.8	4.9	10.9	12.5
b	60	5	—	7.9	25.0	21.3	3.7	14.0	4.9	9.1	12.0
c	60	10	—	7.4	26.8	21.6	5.2	15.8	5.0	10.8	16.5
2a	60	2	+	7.9	22.4	19.3	3.1	5.7	4.9	0.8	....
b	60	5	+	7.9	23.5	21.3	2.2	5.7	4.9	0.8	....
c	60	10	+	7.4	27.8	21.6	6.2	5.4	5.0	0.4	....
1a	100	2	—	7.9	24.3	19.3	5.0	15.1	4.9	10.2	12.0
b	100	5	—	7.9	27.2	21.3	5.9	15.2	4.9	10.3	13.5
c	100	10	—	7.4	27.4	21.6	5.8	15.8	5.0	10.8	19.0
1a	100	2	+	7.9	23.1	19.3	3.8	5.8	4.9	0.9	....
b	100	5	+	7.9	25.0	21.3	3.7	5.6	4.9	0.7	....
c	100	10	+	7.4	25.8	21.6	4.2	4.9	5.0	–0.1	....

LUSTER

1a: Less swollen than Series A 1a.
2a: Less lustrous than Series A 2a; very white.
1b: Same as 1a.
2b: Same as 2a.
1c: Same as 1a.
2c: Same as 2a.

perature there must be a decrease in time, and conversely with a decrease in strength of solution and a decrease in temperature there can be an increase in time without any harmful effect to the tenstile strength.

Effects of Time of Immersion on Extensibility—Time of immersion has no marked effect upon extensibility, but, generally speaking, those under no tension have a slight increase in extensibility with an increase in time, while those under tension are opposite: with an increase in time there is a decrease in extensibility.

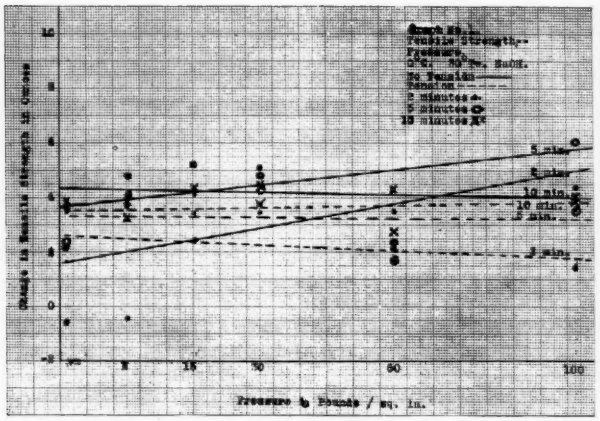
Effects of Time of Immersion on Shrinkage—With an increase in time of immersion there is a slight increase in shrinkage. Time of immersion has no effect on dye affinity.

Effects of Temperature on Tensile Strength—In practically every case there is a decrease in tensile strength with an increase in temperature, with the exception of those mercerized with 70° Tw. at reduced and normal pressure, which indicate a slight increase.

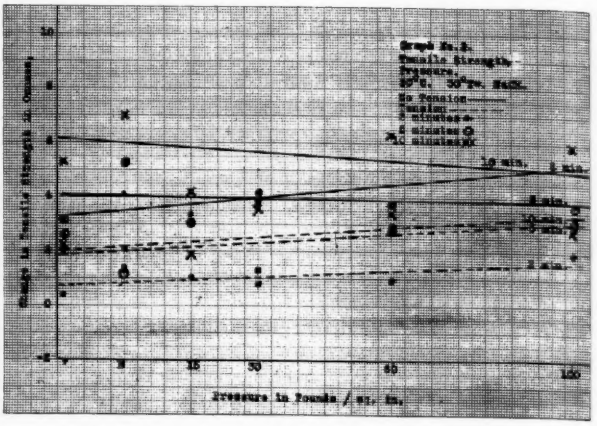
Effects of Temperature on Extensibility—With an increase in temperature there is a decrease in extensibility in those mercerized loose, but those mercerized stretched in 30° Tw. show an increase in extensibility and no change is shown by those mercerized stretched in solution stronger than 30° Tw.

Effects of Temperature on Shrinkage—With an increase in temperature there is a decrease in shrinkage. Temperature of the mercerizing solution has no effect upon dye affinity.

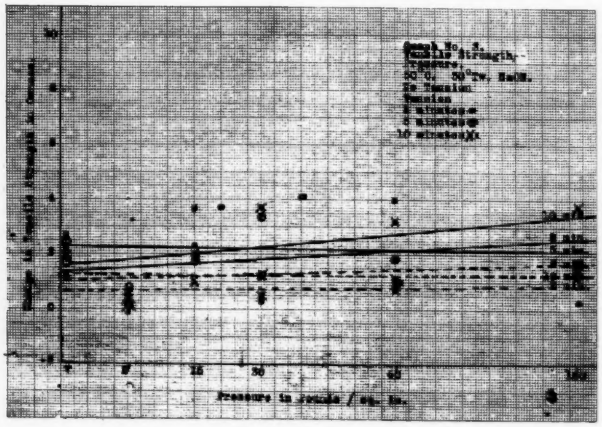
Effects of Strength of Solution on Tensile Strength and on Dye Affinity—The greatest breaking strength, the greatest extensibility, and the greatest shrinkage occur when 50° Tw. sodium hydroxide is used for mercerizing. With an increased strength of solution there is a uniform increase in dye affinity with a slightly darker shade in the no-tension samples than in the tension samples.



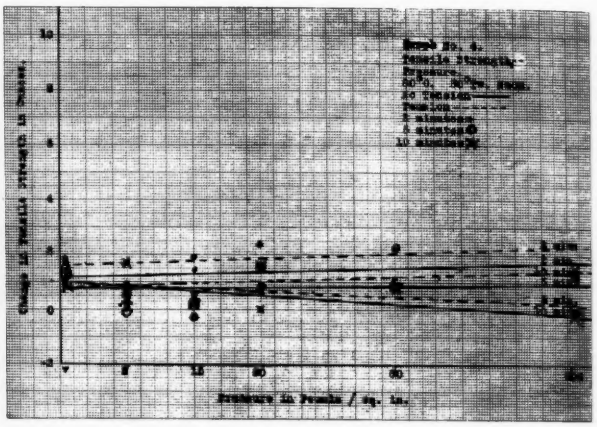
Graph No. 1
30° Tw. NaOH at 0° C.



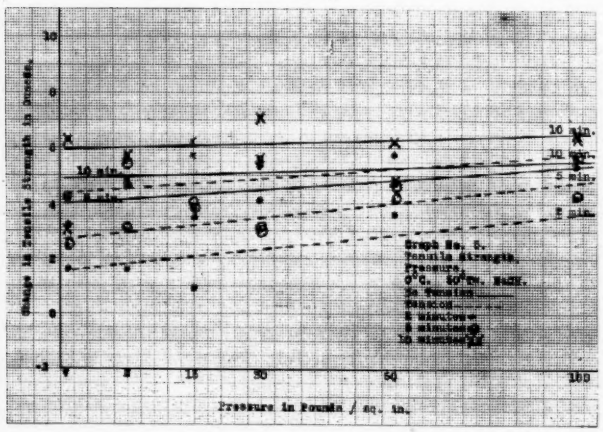
Graph No. 2
30° Tw. NaOH at 30° C.



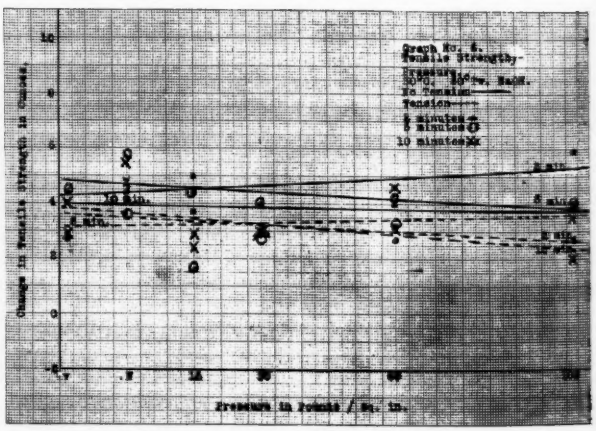
Graph No. 3
30° Tw. NaOH at 50° C.



Graph No. 4
30° Tw. NaOH at 80° C.



Graph No. 5
50° Tw. NaOH at 0° C.



Graph No. 6
50° Tw. NaOH at 30° C.

(*Continued on page* 591)

Proceedings of the American Association of Textile Chemists and Colorists

The American Association of Textile Chemists and Colorists

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REPORT OF SUB-COMMITTEE ON RUBBERIZED FABRICS

INTRODUCTORY STATEMENT

THE report of the Sub-Committee on Rubberized Fabrics which follows, is the result of a critical study of the various methods which were found to be in use for the determination of small quantities of copper, manganese, and iron in textile fabrics. Such methods as appeared to have merit were checked through laboratory investigation, and many modifications were tried out by different workers. The objective of the committee has been to establish an accurate, and at the same time, convenient method, for determining minute quantities of the above-mentioned metals when present in textile fabrics. This work has been actively carried on over a period of nearly two years and while it is not as yet completed, it has been thought advisable to publish the results so far obtained.

This work has been done under the supervision of Dr. Raphael E. Ruff, of the Pacific Mills, chairman of the committee, in close co-operation with Clarence L. Nutting of the Arlington Mills, another member of the committee, A. Nelson MacFarlane of the Pacific Mills, and William C. Smith, research associate of the Association. The latter part of this report is a record of work done by Mr. Smith, for the most part at the Bureau of Standards, and deals with the determinations of manganese, and copper in the presence of iron.

L. A. OLNEY

Determination of Small Amounts of Copper in Textiles

By RAPHAEL E. RUPP
Chairman of Sub-Committee

AMONG the "dangerous chemicals" listed by the Rubber Association are copper over 0.002%, manganese over 0.001%, sometimes iron over 0.1%, and "grease." The deterioration of rubber is due to oxidization for which both copper and manganese are excellent catalytic accelerators. We are informed by the rubberizers that copper in any quantity, however small, is undesirable in fabrics to be rubberized, but .002% can be tolerated without seriously shortening the life of the garment, and .001% in the same way for manganese. Much larger amounts of iron can be tolerated, in fact, iron in the ferric condition is probably not harmful at all. The limit of .1% Fe. was set as one that should easily be met by the textile finisher and would certainly not be injurious to the rubberizer.

The first problem confronting this committee was obviously to investigate the methods for analysis of copper

and manganese. The usual method is to ash the sample, dissolve the ash in hydrochloric acid, or nitric acid, or a mixture of both, make ammoniacal, filter off any metallic oxides or hydroxides which have been precipitated, and compare the color with an ammoniacal solution of known copper content, or to make acid with acetic acid, add potassium ferrocyanide and compare the red color developed to that obtained from a standard copper solution.

The procedure we first followed was:

Ash 20 g. cloth in a porcelain or silica dish (not platinum). To this ash add 5 cc. conc. HCl and 1 cc. conc. nitric acid and boil for one minute. Take up in 10 cc. water and add an excess of ammonium hydroxide. The precipitated oxides or hydroxides are removed by filtering through an asbestos filter. If there is a heavy precipitate, it should be dissolved and reprecipitated and the two filtrates combined. This filtrate is evaporated until the excess ammonia is driven off and then made slightly acid with acetic acid. Standards are made up in 50 cc. Nessler tubes ranging from .00005 to .0005 g. of copper, to each of which add 5 grams of ammonium chloride and 1 cc. of 1% potassium ferrocyanide. To the unknown (or an aliquot portion), add 1 cc. of 1% potassium ferrocyanide, and determine the amount of copper present by color comparisons with the standards.

We offer the following comments on this procedure:

Platinum is not to be used, for a large part of the copper is lost by alloying with the platinum.

A solution containing copper for analysis should never be filtered through filter paper. Cellulose has a very definite affinity for copper and even after continued and repeated washings, a filter paper will hold a considerable fraction of the copper. This affinity of cellulose demonstrates the advisability of avoiding copper in the processing of textiles. When cellulose comes in contact with copper, it grabs on and does not let go readily. This affinity can be seen from the following experiments:

A 20-gram sample of bleached cotton cloth was dipped in 200 cc. of a solution containing copper—the cloth suspended over the beaker so the excess liquor would drain back. About 175 cc. of solution (87½%) was left and both this and the cloth analyzed to find the distribution of copper.

g. Cu in Orig. Solution	g. in Residual Solution	g. in Cloth
.003 g.	.0005	.0025
.0015	None	.0015
.0010	None	.0010

A solution containing .0015 g. or less copper was completely exhausted although only 12½% of the liquid was absorbed. Although no similar date is presented, wool has an ever greater affinity for copper than cellulose.

The ammonium chloride is added to the standard to produce a turbidity in the standard similar to that in the the unknown. Copper ferrocyanide is colloidal and the ammonium chloride formed from the hydrochloric acid and ammonia tend to precipitate it. Using this procedure we added definite amounts of copper to cotton and wool fabrics and then analyzed for the copper:

Fabrics	Copper Known to Be Present	Copper Found	Error
Cotton	.0125%	.0125%	None
"	.0078	.0075	4%
"	.0053	.0050	6%
"	.0035	.0035	None
Wool	.0013	.0013	None
"	.0065	.0065	None
"	.0040	.0040	None

This method is apparently quite accurate for copper in wool or cotton where there are no foreign materials. The cloth used in both cases was bleached and ready for dyeing or printing.

If chromium happens to be present the ashing is more difficult and the results show that not all the copper is found. The same woolen and cotton fabrics were treated with ½% solution of potassium chromate, and the following results obtained:

Fabric	Copper Known to Be on Cloth	Found	Error
Cotton	.0053%	.0050%	6.%
"	.0028	.0025	11.
"	.0100	.0075	25.
"	.0013	.0009	30.
Wool	.0050	.0020	60.
"	.0050	.0025	50.
"	.0042	.0030	28.
"	.0025	None	100.

In order to get any results at all when chromium is present about 5 cc. of barium chloride (10%) had to be added along with the ammonia. Without this a yellow color persisted which interfered with the colorimetric determination of copper.

Treating the cloth with sulphuric acid and moistening with sulphuric acid during ashing, so the ash was always acid, was suggested and tried with these results:

Fabric	Copper Orig. Present	Copper Added	Copper Found	Error
Wool	.0015%	.0050%	.0020%	69.2%
"	.0015	.0050	.0005	92.

In every case the copper found is much lower than the correct value. As these fabrics are much more difficult to ash when chromium is present, particularly the wool, it is our opinion the loss is due to some of the copper being fused into the dish. A procedure has been recommended fusing the ash with sodium carbonate in the porcelain dish; but porcelain and silicia dissolve too readily in fused sodium carbonate for this to be satisfactory. Fusion with potassium acid sulfate would not completely

remove the copper. We were able to demonstrate that some of the copper was held by the porcelain dish, by fusing bits of the dish with sodium carbonate—potassium carbonate mixture and getting a positive test for copper from this fusion mass. From the above analyses, it is readily perceived that where there are no other metals which make ashing difficult, this method may be used with accuracy, but where chromium is present, it is not satisfactory.

For some time the Arlington Mills' laboratory has been using a method for copper analysis, where the organic matter is destroyed by a digestion with sulphuric acid and nitric acid in a Kjeldahl flask. We have followed this procedure: Digest 10 or 20 g. of cloth (depending on the copper content) in a Kjeldahl flask with 25 cc. conc. HNO_3, 25 cc. conc. H_2SO_4 and 5.0 g. K_2SO_4. This digestion will proceed vigorously with very little heating at first. After the reaction slows down, it is heated rapidly until a clear melt of about 2-5 cc. is obtained. This solidifies on cooling. It is then taken up with water, made ammoniacal, filtered through asbestos and the copper determined colorimetrically with potassium ferrocyanide by the same procedure from this point as in the previous method. The chromium does not interfere. It is probably reduced in the digestion and removed by the filtration.

We find the red of the copper ferrocyanide to be more sensitive and accurate than comparing the ammoniacal blue with a standard copper solution made ammoniacal.

Following this procedure, we obtained these results on fabrics first treated with ½% of potassium bichromate solution:

Fabric	Copper Known to Be Present	Copper Found	Error
Cotton	.0016%	.0017%	6.2%
"	.0031	.0032	3.2
"	.0031	.0033	6.4
"	.0057	.0056	1.8
Wool	.0045	.0045	None
"	.0075	.0070	6.6
"	.0125	.0120	4.0

Here the errors are much smaller and are both plus and minus in sign, while in the ashing procedure all the results were lower than the correct value.

We have not completed our investigation of procedures for manganese at this time. Iron can be determined in the usual gravimetric or volumetric way without any difficulty.

We were interested in the amount of copper present in these fabrics as they come to the dyer, printer or finisher and found:

Gray cloth from the looms.....	.0003 to .001%	Copper
Bleached cotton	.0003 to .001%	"
Cotton and viscose mixtures....	.0005 to .001%	"
Cotton and cellulose acetate mix.	.002 to .004%	"
Bleached wool	.001 to .002%	"
All cellulose acetate fabrics.....	.004 to .005%	"

The finisher of all cotton or cotton and viscose has a margin of .001% to work on. The wool finisher has practically no margin, and to keep below the rubberizer's limit of .002% the finishers of cellulose acetate must devise a copper extraction method.

A Method for Determination of Copper, Manganese and Iron in Fabrics

By Wm. C. Smith

Research Associate, American Association of Textile Chemists and Colorists

I. Purpose

THE purpose of this work is to establish an accurate, convenient method for the determination of copper, manganese, and iron in textile fabrics when they are present in quantities approximately as follows: copper .002%, manganese .001%, iron .1%.

II. Experimental Work

For destroying the organic matter in the sample for analysis, the method worked out by the sub-committee has been used. A 10-gram sample is placed in a 500 cc. Kjeldahl flask together with 2.5 grams anhydrous sodium sulphate and 2.5 grams potassium sulphate. 25 cc. of fuming nitric acid are added and when the action ceases 25 cc. of concentrated sulphuric acid are added. The flask is heated gently, if necessary, until the evolution of nitrous fumes ceases. It is then heated with a strong flame until the mixture is free from carbonaceous material. If the inside of the flask is not clean at this point it is allowed to cool and about 2 cc. of concentrated sulphuric acid are added and the flask is heated again. When the digestion is complete the flask is allowed to cool and the mixture is dissolved in 50 cc. of water.

Several methods of analyzing the solution thus obtained have been tried. Two methods which involved separation of the three metals were tried out but both required considerable manipulation and they were not investigated thoroughly because a third method showed promise of giving satisfactory results without separation. In this method the products of the digestion are dissolved in water and diluted to a definite volume from which aliquot portions are taken for the determination.

A. *Copper*—The xanthate color reaction for copper was chosen because it is fairly well known and under the proper conditions the allowable limit of iron does not interfere. Four xanthate compounds were tried with solutions containing only copper sulphate in the amounts that were most suitable for the color reactions. Potassium xanthate, potassium methyl xanthate, potassium propyl xanthate and potassium ethyl xanthate were compared. The potassium ethyl xanthate gave the best results. It produced a clear yellow color of good strength which did not fade sufficiently to affect the determination. In a

description of the potassium ethyl xanthate method for copper given in Scott's Standard Methods of Chemical Analysis, fourth edition, Volume I, page 197, it is stated that the solution for test should be neutral or only very slightly acid. Experiments showed, however, that the amounts of acid given in the procedure below did not affect the results. When iron was present in the copper solution, the addition of potassium ethyl xanthate solution produced a dense cloudy precipitate which interferred with the test. Addition of phosphoric acid before addition of xanthate solution prevented the formation of this precipitate and a clear yellow color, which did not differ from that produced with copper alone, was obtained. Solutions were prepared containing copper, manganese and iron in varying amounts up to the limits allowable. These solutions, when tested according to the procedure given below, gave very good results. Six 10-gram samples of Whatman's No. 40 filter paper were taken as representing textile material for analysis. To four of them, additions of copper were made in varying amounts up to the limit allowable and to three of the samples, manganese and iron were added. The samples were then digested and the solutions were treated according to the procedure given below. The two samples to which no copper was added showed the presence of copper in amounts nearly equal to the limit. For this reason and because there is no assurance that this filter paper is constant in copper content, it was decided to select some other material as a starting point for addition of metals and subsequent analysis.

B. *Manganese*—The potassium periodate colorimetric method (Willard and Greathouse, J. Am. Chem. Soc., 39, No. 11, November, 1917) was chosen for manganese. When solutions containing the three metals were tested for manganese and compared with standards containing only manganese very good results were obtained. Three of the digested samples mentioned above contained manganese in varying amounts up to the limit and the manganese was determined as given below with errors of less than 10% of the amount present. The amount of manganese found in the filter paper was so small that it could scarcely be detected in the solutions used.

C. *Iron*—The sulphocyanate colorimetric method was chosen for iron. This test did not at first seem satisfactory with the acid solution from the digestion, as the colors faded rapidly. However, it was found that this fading could be overcome by adding a large amount of alcohol or a little nitric acid to the solution in which the color was produced. Three of the digested samples as above contained iron in varying amounts up to the limit. The iron was determined with an error of less than 10%. The amount of iron found in the filter paper was so small that it could not be estimated in the solutions used for the determination as given below.

III. Method

The mixture from the digestion as described above is dissolved in 50 cc. of water. Concentrated ammonia is then added to this solution until the iron present gives a reddish yellow color which does not disappear or until the solution is just alkaline to Congo red paper. The solution is then made just acid to Congo red paper with 10% (by volume) sulphuric acid and then a 5 cc. excess of acid is added. The solution is then diluted to 200 cc. For copper, 30 cc. of the 200 cc. unknown solution are pipetted into a beaker, 5 cc. of 10% phosphoric acid are added. (10 cc. of 85% phosphoric acid diluted to 100 cc.) 3 cc. of 0.1% potassium ethyl xanthate solution are then added slowly with stirring and the solution is transferred to a 50 cc. Nessler tube and diluted to the mark and mixed. This solution is then compared with the series of standards.

For manganese, 100 cc. of the unknown solution are pipetted into a 200 cc. Erlenmeyer flask. 20 cc. of 85% phosphoric acid and about ½ gram of potassium periodate are added. The solution is boiled about one minute and then heated just below the boil for about ten minutes. It is then cooled and diluted to 200 cc. 50 cc. of this solution in a Nessler tube are compared with the series of standards.

For iron, 1 cc. of the unknown is added to about 10 cc. of water in a beaker, 1 cc. of 25% (by volume) nitric acid is added and 5 cc. of 10% potassium thiocyanate solution are then added slowly with stirring. The solution is then transferred to a 50 cc. Nessler tube and diluted to the mark and mixed. It is then compared with the series of standards.

Standard copper sulphate solution is prepared with .1571 gram copper sulphate crystals dissolved in sufficient 5% (by volume) sulphuric acid to make 1 liter. 5 cc. of this solution then equal the allowable limit for a 10-gram sample. Solutions are prepared containing, in 200 cc., 3.5, 4, 4.5 and 5 cc. of this standard solution. From each of these solutions, 30 cc. is pipetted into a beaker and 3 cc. of 0.1% potassium ethyl xanthate solution are added slowly with stirring. Each of these solutions is then transferred to a 50 cc. Nessler tube and diluted to the mark.

Standard manganese solution is prepared as follows: 250 cc. of solution containing .0576 gram $KMnO_4$ per liter are reduced by adding 3 cc. of 6% sulphurous acid. The excess sulphur dioxide is then boiled off and the solution is cooled and diluted to 500 cc. 5 cc. of this solution then contain manganese equal to that present in the permanganate test solution obtained from a 10-gram sample containing the allowable limit of manganese. 3.5, 4, 4.5, and 5 cc. portions of this solution are added to a series of 200 cc. Erlenmeyer flasks each containing 100 cc. of water, 20 cc. of phosphoric acid and ½ gram of potassium periodate are added to each. The solutions are

boiled about one minute and then heated just below the boil for at least ten minutes. They are then cooled and diluted to 200 cc. 50 cc. of each solution are placed in Nessler tubes as standards.

Standard iron solution is prepared by dissolving 22.5477 grams ferric ammonium sulphate crystals in sufficient 5% (by volume) sulphuric acid to make 1 liter. 5 cc. of this solution then contain an amount of iron equal to the limit for a 10-gram sample. 3.5, 4, 4.5, and 5 cc. portions of this solution are then diluted to 200 cc. 1 cc. of each of these solutions is added to about 10 cc. of water in a beaker. 5 cc. of 10% potassium thiocyanate solution are then added slowly with stirring and the solutions are transferred to 50 cc. Nessler tubes, diluted to the mark, and mixed and used as standards.

IV. Proposed Further Work

Use some more suitable material than filter paper for addition of known amounts of metals and subsequent analysis.

Shorten the procedure in preparing standards if possible.

Adapt the method to determinations in which the sample for analysis contains interfering elements such as chromium.

Determine whether the method is suitable when one or more elements are present in large amounts. For example, find how much iron may be present without interfering with the determination of copper.

Analyze typical fabrics and compare the results obtained with those obtained by other laboratories on the same fabric.

Practical Applications of Ultra-Violet

By Chester A. Amick

Presented at Meeting of Northern New England Section, March 22, 1930

THERE are many opportunities of applying ultra-violet in the textile industry. Obviously, the available time will preclude a complete discussion of all of these opportunities, but those mentioned will give a general idea of the possibilities.

One of the stains frequently met with in textile finishing is that caused by machine oil or grease. The generally accepted procedure for such a stain follows: Place a piece of the fabric containing a part of the stain in a five per cent sodium hydroxide solution and boil a few minutes. Wash, and examine. If the stain persists, add a little red oil to the stain and reboil in the same alkali for five or ten minutes. Mineral oil should be removed by this treatment.

If ultra-violet is available, the stain will give a distinct luminiscence when the cloth containing the soil is irradiated. If machine oil is suspected, this may be sufficient. However, vegetable oils also fluoresce when placed in ultra-violet light. It is possible to distinguish between mineral and vegetable oil fluorescence with practice. If some doubt persists as to the true identity of the oil causing the stain, the piece of fabric can be boiled in the dilute alkali as mentioned above, whereby the vegetable oil is removed. Obviously, the alkaline boil cannot be successful on wool or silk which enhances the value of ultra-violet irradiation.

Should the stain be caused by old grease from bearings, enough extraneous material may be present in the grease to absorb the radiation and mask the action. The addition of a little ether, drop by drop, to the stain will dissolve sufficient oil to give a "fluorescent ring" surrounding the grease spot. Best results seem to be obtained if the ether is added while the cloth containing the soil is being irradiated.

This general scheme may be employed in any instance where the fluorescent substance has its fluorescence temporarily inhibited because of extraneous material.

It has been mentioned that vegetable oils have a characteristic luminescence when irradiated with ultra-violet. Fortunately for the analyst, the color and extent of this fluorescence varies with different substances. Commercial olive oil fluoresces very slightly, much less than rape seed oil which sometimes is used to adulterate the olive oil. However, the addition of 10% rape seed oil to olive oil can be detected by ultra-violet examination.

Castor oil has a characteristic luminescence similar to that of olive oil, whereas linseed oil has a brilliant yellow fluorescence. Red oil (oleic acid) also fluoresces strongly without the yellow tint so typical of linseed oil.

Some Characteristics of Colors in Ultra-Violet

Although it has long been known that substances derived from fluorescein have a peculiar luminescence in ordinary light, the distinctive luminescence of many substances when irradiated by ultra-violet is comparatively new.

As Prof. Stockbarger has summarized, ultra-violet light should be considered as a mixture, whose properties depend upon its composition. Consequently, it is necessary in establishing tables of colors and intensities of luminescence that the character of the source of irradiation be accurately defined. This will enable students of ultra-violet radiation to properly evaluate the researches published from time to time.

The use of ultra-violet in the study of dyes will be discussed here from two angles only:

1. The identification of certain dyestuff groups.
2. The change in fluorescence when the dyestuff is applied to various fibers, or when it is applied in various ways.

As the researches on ultra-violet are extended, other uses will develop.

1. A beautiful luminescence is obtained when members of the Thiazol group are irradiated by ultra-violet. A good example of this is Primuline on cotton. Certain

Phthallic Anhydride derivatives as Rhodamine and Eosine show a beautiful luminescence on wool and silk. Direct Brilliant Yellow 3GN, Dianil Yellow 5G, Fastusol Yellow RT, Direct Fast Pink FB, Diazo Fast Yellow G and GG, Primuline SX and Diazo Yellow R are typical of the colors which give a silvery luminescence, while Diamine Scarlet B, Direct Red DCB, Direct Red DC, Benzo Bordeaux 6BA, Direct Red 6B Ex., Benzo Rhoduline Red B, Geranine G, Benzo Rhoduline Red 3B, Brilliant Benzo Violet RR and Chloramine Violet FFB give beautiful, richer colors than they do when viewed with ordinary light. Generally, the red portion is augmented by ultra-violet irradiation, and one has to regret that these beautiful colors disappear in daylight.

2. The change in luminescence of a dyestuff when applied to various fibers is shown by such dyes as Auramine and Rhodamine which fluoresce brightly on wool and silk but not on cotton where they are fixed with tannin. It has been suggested that the weight of this color—tannin molecule may prevent fluorescence. Similarly, developing certain colors destroys their fluorescence when exposed to ultra-violet light. Thus, Diazo Fast Yellow G and Primuline SX fluoresce when dyed on cotton, if the color is not developed. Subsequent development of the first one by Developer Z and of the second by ZA, or Chlorine, eliminates the fluorescence.

These are merely a few of the many examples which might be noted. However, the striking luminescence of the cravates of those present, when exposed to the ultra-violet rays of Prof. Stockbarger's lamp, indicates the possibilities of this new tool of the textile research worker.

Some Characteristics and Uses of Ultra-Violet

By DONALD C. STOCKBARGER

Presented at Northern New England Section Meeting March 22, 1930

IN 1666 Sir Isaac Newton cut a small hole in his "window shuts" thereby permitting a narrow beam of sunlight to enter his room. When he held a glass prism in this beam he was delighted to see on one of the walls what to-day is known as a visible spectrum. Through very careful experimentation he learned a great many things concerning light among which was the fact that it was composed of a number of components, each of which produced a different color sensation. It is probable that he did not even suspect the existence of other radiations lying beyond the red on one side of his spectrum and beyond the violet on the other.

It was not until 1801 that the ultra-violet spectrum was discovered by Ritter. He found that when the spectrum was allowed to fall on silver chloride the photochemical change took place not only where the blue and violet radiations fell but also in the dark region beyond the violet. We know to-day that the ultra-violet spectrum is composed of many invisible "colors," each having its own properties and characteristics which are in general as different from one another as those of red and green light. Since it was impossible to name them according to visual sensations they have been assigned numbers denoting their wave-lengths. The units employed are commonly microns, millimicrons and Angstroms. 4000 A. radiation, for example, is violet light. The spectral region between 4000 A. and 3000 A., roughly, is known as near ultra-violet, while that between about 3000 A. and 1850 A. is far ultra-violet.

Inasmuch as sunlight contains only near ultra-violet whereas most of the powerful laboratory sources emit both near and far ultra-violet, and because the rays are capable of producing widely different effects, it is highly important to realize that the photochemical processes which we carry out in the laboratory are often not the same as those which occur naturally in sunlight. Taking dye-fading as an example, it may be found that of several materials which fade readily under an open arc some are very resistant to the action of sunlight. We must, therefore, take precautions to duplicate sunlight as closely as possible, not only as to the spectral energy distribution, but also as to the short wavelength cutoff. In other words, it is well for us to be sure that we have from our artificial sources practically all of the rays which are in sunlight in somewhere near the same proportions, and that we do not have rays of shorter wavelength. To guard against the latter we can easily make use of some one of the number of special glass filters which are readily obtainable. Even in the field of therapeutics there seems to be a tendency at present to screen off the short wavelength radiations generated by the arcs.

Two white objects having the same reflectivities for visible rays appear alike when viewed by ordinary light. It may happen, however, that one of them reflects some one kind of ultra-violet much more readily than does the other so that a photograph properly made by means of this ray would reveal differences hitherto unsuspected. The "appearance" of an object in ultra-violet may be further influenced by fluorescence. Utilization of these facts in ultra-violet photography in the examination of palimpsests and altered documents of various kinds has become fairly common during recent years. The criminologist, as you see, has found a use for the same tool which is serving the textile chemist affectively.

In therapeutics it has been assumed for several years that the so-called "vital ray" region lying somewhere between about 2900 A. and 3100 A. is of particular importance. Many have come to believe that any source of radiation which emits "vital rays" is a satisfactory substitute for the sun. In the light of what we have learned about radiation it is perhaps reasonable to question whether or not the "vital ray" region is being overemphasized. We will grant that the importance of the "vital rays" has been demonstrated as has that of vita-

min A. I am sure, however, that none of us would consider trying to exist on a diet consisting wholly of vitamin A nor would we neglect the kinds and proportions of the things which we mix with it. In this case nothing is being said to indicate that any harm might result from the use of almost any kind of artificial ultra-violet sources. I am only suggesting that other rays besides the "vital" ones are important, and that if the radiations are to produce the same effects as would sunlight it is probable that they should duplicate sunlight as closely as possible in their general composition. There can be no doubt concerning the benefits to be derived from properly administered radiation, particularly in the case of growing children.

For those who, for any reason, do not wish to or cannot avail themselves of artificial therapeutic sources. several manufacturers have developed special window glasses which may be used to replace the old ones which do not transmit the "vital rays." Inasmuch as these materials are finding use as filters with which to control the quality of radiation obtained from arc lamps I want to discuss briefly the question of solarization concerning which false rumors have been current. It was discovered a few years ago that the "vital ray" transmission of some of the most popular special glasses were lower after several months of use than they had been when new. This led someone to suggest unwisely that after a period of time this transmission would fall off altogether so that the windows would be no better than ordinary ones. Most careful experiments have, however, demonstrated beyond all reasonable doubt that the depreciation is not very great in the first place and that it does not continue indefinitely. Apparently the major portion of the drop in transmission occurs within a few days of exposure to sunlight and after a comparatively short time the action ceases so that, barring accidents, a special window should be just as useful fifty years from now as it is one month after installation.

This discussion refers, of course, to exposure of the glass to sunlight or to artificial radiation of similar quality. Even when exposed to bare arcs the better materials (at least those which I have examined) do not degenerate into common window glass, but they do lose more of their effectiveness as ultra-violet transmitters than they do when exposed to sunlight. We have here another example of the difference between the actions of near and far ultra-violet radiation. It is an important example, too, because errors may result from the use of natural solarization data in connection with bare arc processes. A glass, which transmits 50 per cent of the incident radiation at 3000 A. when the sun is the source, may transmit only about 30 per cent at the same wavelength when a quartz mercury arc is the source.

The subject is one which could be extended more or less indefinitely. It must suffice, however, to leave these thoughts with you, and to emphasize once more the point that the ultra-violet rays are not all alike in their properties. Do not make the mistake of considering ultra-violet as a single thing. Think of it rather as a mixture. The properties of a mixture depend on the composition.

The Advantages of Bleaching Textiles with Hydrogen Peroxide

By D. Stewart Quern

Field Representative, Buffalo Electro-Chemical Co., Inc.

Presented at South Central Section Meeting, July 26, 1930

IN PRESENTING a paper relating to the advantages of bleaching textiles with hydrogen peroxide, it is logical to give first a brief discussion of peroxide processes for comparative purposes, and further to discuss, so far as is possible in the scope of this paper, those features which have contributed to the greatly increased use of hydrogen peroxide as a bleaching agent.

The subject as stated, "Peroxide Bleaching," covers a wide range of sub-heads which could all be discussed extensively. I refer to the peroxide bleaching of hosiery, woolens, silk piece goods, yarns, and peroxide bleaching conducted in Rodney Hunt machines, and that which is done in kiers. It is my intention, however, to discuss principally kier bleaching with hydrogen peroxide, inasmuch as this constitutes such a large proportion of the total volume of peroxide bleaching, and also because some of the most interesting developments have come in this particular field. I shall, therefore, first describe the operations of a typical hydrogen peroxide kier bleach, and then discuss those factors which have led to the kier bleaching of fabrics which may heretofore have been considered as not most suitable for peroxide processes.

Since peroxide bleaching of piece goods is accomplished in the kier, it is in order to first ask the question: What kind or type of kier is most suitable? To state the matter simply, kiers of the steam jet or injector type circulation, and kiers equipped with pump and outside heater, or being heated with steam coils in the false bottom of the kier, may both be used successfully for peroxide bleaching. This statement is made with the knowledge that there is a widespread impression that kiers of the first named, that is, injector type circulation, cannot be used for peroxide bleaching, but the number of plants using this type kier successfully gives evidence of its adaptability. Nevertheless, there is a distinct tendency to favor pump kiers with the closed coil heating for peroxide bleaching. This preference finds basis principally in the fact that dilution of the bleaching liquor is avoided in pump kiers. This is worthy of consideration, but we must not overlook the obvious fact that this dilu-

tion reaches the peak at the point where the peroxide concentration is lowest, regardless of the type kier, that point of course being the conclusion of the bleaching operation.

While I am speaking of iron kiers in the foregoing, a certain small proportion of peroxide bleaching is done in wooden kiers, fitted with pump and heater. Such equipment is usually found in plants where the bleach output is comparatively small, and is not used to any great extent by those plants doing peroxide bleaching on a quantity basis. While theoretically wooden kiers offer utmost freedom from catalytic action on the bleaching chemicals, this supposed advantage will be found by actual comparative tests to be so negligible as not to be worthy of consideration where the iron kier equipment is kept in anything like ordinary good condition.

We come now to the bleachng operation, and as an example, I shall present a kier bleach accomplished in this way: Goods wet out and loaded into the kier, submitted to a bleaching solution of hydrogen peroxide and silicate of soda for the required number of hours, finally being pulled out through washers into the white bins. The temperature used for a hydrogen peroxide bleach bath will range from a minimum of 180° F. to boiling with the higher temperatures favored for attaining the maximum in results.

The simplicity of such a process as described is at once apparent. There are, however, certain factors and requirements in the cotton mill bleachery which bear decided influence upon the methods and procedure by which peroxide is used. The time element, expense of operation, and the condition of bleached cloth as regards absorbency and satisfactory dyeing qualities are all matters to be considered in relation to the process. A brief process such as I have just described might prove very satisfactory from the standpoint of results and the time involved, but not best suited where other factors must be considered.

We therefore account for the greatly increased practice of preparing goods for the hydrogen peroxide-silicate bath by means of a preliminary alkaline treatment or boil-off, or desizing, or both, proceeding on the principle that well prepared goods will be well bleached goods, regardless of the oxidizing agent, and in addition will be in better condition for dyeing where this is necessary. Preparing goods well before the peroxide bath has been a decided factor in the wide expansion of peroxide bleaching. This is particularly true because the total expense of chemicals necessary is considerably less where preliminary treatment has preceded the peroxide bleach.

In speaking of preliminary boil-off before peroxide bleaching, it will be well to be more explicit about this. In some cases, it may be found advisable, particularly where goods are very dirty, to submit the goods to a pressure boil-off in caustic soda, while in other cases, short open kier boils are sufficient. Regardless of what treatment goods may receive before the peroxide bleaching operation, it must be emphasized again that once the goods leave the kier, the entire procedure has been completed.

Dyeing of bleached goods is a most important matter, and it is natural to inquire into the dyeing qualities of peroxide bleached cloth. The dyer wants the goods to reach him from the bleach house with a good white, of course, but he is primarily interested in cloth that is not going to show resists or take an excess of dyestuff to obtain his shades. Well prepared goods are essential to him in connection with his peroxide-bleached cloth. Many comparative tests as to the relative dyeing qualities of cloth bleached by different peroxide methods have been made in plants using this bleach. While the bleach would be unquestioned in every case, the best results would be obtained where the goods first received the caustic boil-off before the peroxide bleach.

I shall now direct attention briefly to the bleaching of colored goods, such as shirtings, towels, etc., with hydrogen peroxide. Peroxide bleaching of this class of goods is universally favored, because of the simplicity by which such goods can be handled, and also because of the maximum of safety it offers for the colors. Bleaching of colored goods may be accomplished in very much the same manner as has been described for all white goods, but any pre-treatment given must necessarily be of a modified character. Procedure here differs somewhat in the application or extent of such preliminary treatments, but in most plants, some preliminary treatment for colored goods is looked upon as best practice.

As I have stated, the hydrogen peroxide process is completed in the kier, meaning, of course, that it is not necessary to pull cloth around the bleach house before reaching the white bins. This feature may well be considered worthy of consideration in the bleaching of all materials, and particularly important to the bleachery processing light fabrics where the least handling possible is desirable. Naturally the bleachery wants to turn out a piece of cloth of this type, not only just without damage, but in as perfect condition as possible, and peroxide offers considerable advantage in obviating the necessity of pulling light fabrics over a number of machines. Crooked fillings may often result from much pulling around of such fabrics, and this is a problem most easily solved by peroxide bleaching by reason of the lesser handling involved.

AMERICAN DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

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RAMBLES IN FASTNESS

IT SHOULD be thoroughly understood that there is no such thing as absolute fastness in dyes. If experience proves that a dye used for a certain purpose keeps its shade, it is said to be fast; at least, it is fast so far as that particular use is concerned. However, the same dye used for another purpose might prove to be extremely fugitive.

At the present time, when we hear so much about fast dyestuffs, and the importance of them, we are apt to forget that the same questions have been in the minds of dyers ever since dyeing was first carried out. The ancient Egyptians were probably the first to start the demand for fast dyes. Moreover, they succeeded in obtaining a purple from a shellfish that has been able to withstand centuries. An examination of the old mummy cloths proves this. The dyeing of Indigo was carried out in India hundreds of years ago. Indigo was, and still is, in some places dyed by the crudest fermentation vat methods. That crude dyestuff and the primitive methods of application marked the real beginning of the modern fast dyes.

After the use of Indigo was established, other natural dyestuffs, such as logwood, fustic and the mineral colors were discovered. In those days they were relatively fast; some of them were extremely fast to certain color destroying agents.

Many of the dyes referred to would today be called very fugitive, simply because in relation to the newly discovered colors, they would not be nearly so fast. Then, too, there are now other considerations than sunlight to be taken into account when judging fastness. For instance, many of the modern dyestuffs, in order to be called fast, must be able to withstand the severe processes of crabbing, steaming, cross-dyeing, boiling with acids and kier boiling.

The gradual introduction of these processes has been kept pace with by the gradual lengthening of the list of dyes—fast and otherwise. Not only have new dyestuffs been discovered, but new classes of dyes, and new methods of application. With the greater use of the vat dyes, and especially in view of their coming use on wool, some may think that the ultimate in fastness has been obtained. However, past experience would seem to show that there can be no end to progress in this direction. Dyestuffs will continue to be improved just as long as they are used.

Even though some laymen may ridicule the modern dyer's attempts at fastness, and point out the almost everlasting fastness properties of some vegetable dye, it is, of course, well known that modern science has produced an almost infinite number and variety of shades that are far faster than the natural dyes. It should be remembered that centuries ago price was a minor consideration. Today we have to face the fact that increased production and low costs are paramount factors. Cheap goods are naturally to be colored with cheap dyes, which will probably be far from the fastest obtainable. Modern fashions and customs, too, have taken a hand in the fastness requirements. Some garments go out of style after a short period of use. In such case, it would be useless to spend a large sum for color when for a small sum colors could be used that would last for the length of time the fabric was in style.

There is no doubt that fast colors can be obtained on any material if the consumer is willing to pay for them. He should realize, however, that when he buys cheap goods, manufactured on a production basis, they have been made with so small a margin of profit that expensive fast dyes could not possibly be used.

REST PERIODS

THERE are many things that are done in the field of research that appear to be quite foolish; for example, it was determined by actual experiment that if a man lifted a weight with his middle finger until is completely gave out, it required a rest of two hours for its complete recovery. However, it was also found that when the finger was only worked for one-half as long, it required but one-quarter the time to recuperate.

Of course, such an experiment seems about as useless as endurance flagpole sitting, but it does illustrate a fundamental principle of interest to those who are in charge of labor. It emphasizes the fact that rest periods, instead of cutting down production, increase it.

Take the case of a young man working in a dyehouse laboratory: he may be the most industrious and conscientious young man in the world, but that, in itself, will not keep him from becoming totally sick of his work after he has spent many hours without a break tending to dyeings. The result easily can be guessed. He will slow up on the job, become careless and, consequently, not give his best to the work. Dyeings will come out

uneven, skeins will be off shade and much time will be wasted repeating a great deal of the work.

The laboratory worker, spoken of above, scarcely could be blamed for his let-down. He had simply become so fatigued that his morale had just broken. Wouldn't it be better in all cases to give the employee time for rest, and thus eliminate much of the poor work that is done by tired workers. Of course it would. Even if the higher production were left out of consideration, the better feeling on the part of the employees alone would more than make it worth while.

In regard to the time for rest periods, much can be said in favor of allowing the workers to rest at their own discretion. In the first place they would not feel that they were being driven. If they were men of the proper type they could be trusted to take their time out when it would least hold up production. It is well known that in almost any line of work there are times when there is nothing to do. An employee of the right sort could utilize these slack periods for his time out—that is, if he did not think his employer would object to seeing a subordinate doing nothing. Many times fear of being seen resting makes a man continue to work, or appear to work, when really he has nothing to do.

If a man is worth having as an employee, he is worth being given due consideration. A few might take advantage of the fact that they could rest whenever they so desired, but they soon could be weeded out. The others, using the privilege in the right way, would be far better employees and would feel more like giving their best to the company.

EXTRACTORIALS

Mr. Evans said that, in common with all other organizations, the university had undergone a new orientation. The scope of the higher branches of learning had been broadened, and, owing to the complexity of modern industrial problems, there was an increasing tendency on the part of industry to reach out to the university for some guidance. The university graduate who intended to become a leader of industry must be equipped not only with technical and scientific knowledge of the broadest kind, he must have vision and a knowledge of the world and men. Academic training alone would not suffice, and he would urge students to take every opportunity, during their vacation, to enter the practical field of industry and thereby cultivate sympathetic contact with those workers who had not the privileges of a higher education, but who, nevertheless, were men skilled in their work, and were the foundation of most industrial processes.—*Chemical Age.*

It is true that some progress is being made toward the elimination of factory injuries, but the headway that is being made is not anywhere near what it should be. Perhaps it is because we do not know enough about the causes of injury. *Fatigue, worry,* and *inexperience* have often been pointed to as being conductive to broken bones, but we find in looking over extensive records that these are not the main causes.

The thing which is responsible for the large bulk of human suffering is the "wrong attitude." This doesn't mean disloyalty, antagonism, or any thing of that nature. It merely means that the employer and employee alike fail to see danger where it exists. A good many men do not know that they are skating on thin ice until they break through. We must sharpen our eyes and ears to the point where we recognize hazards.—*Consolidated News.*

"Standards should be created for all materials. These should include minimum specifications for yarns, piece goods, and manufactured articles. They should embrace tests, the results of which will convey to the ultimate consumer the desired information.

"Many of you present may claim that such a procedure will build up sales resistance because of consumer doubt. I must emphatically state, however, that I cannot agree with you, because we have experimented and we are in a position to know.

"Two years ago we notified our public that we did not guarantee the wearing qualities of transparent velvets. Ladies who considered the life of the garment more important than style bought other merchandise. The sale of transparent velvets, however, increased by leaps and bounds, and the complaints dropped to nil."—*Ephraim Freedman in B.L.N.A.*

To obtain the greatest return from the scientific type of management, the teaching function is vital, for it becomes necessary that, all along the line and in the staff which co-ordinates functions, there be a constant flow of expression of aims, policies and objectives and a continual understanding of facts, plans and ideals.—*Kendall in Executives Service Bulletin.*

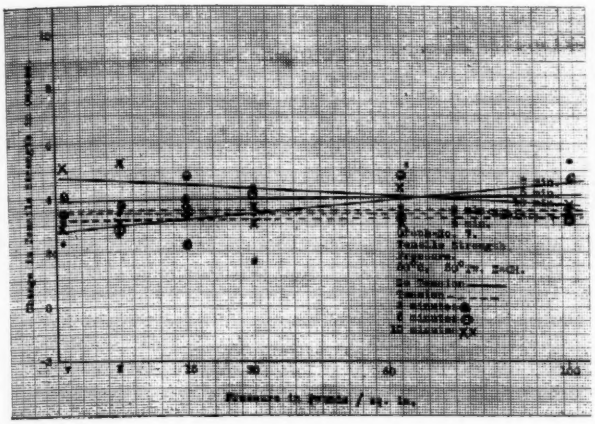
Of German chemicals only coal tar dyes have shown a decline in export. These have declined from 25 per cent to 15 per cent. Foreign markets are reported as having recently become somewhat less active. The most important market for Germany is East Asia, which now takes 15 per cent of the world production—exactly the same amount as was formerly absorbed by the United States.—*Journal of Commerce.*

That there is always a better way to do the job and that workmen are showing keen interest in trying to find that better way is indicated by a report of the General Electric Company showing that for the first six months of this year $56,974 was paid to employees for suggestions of plans to improve their jobs.

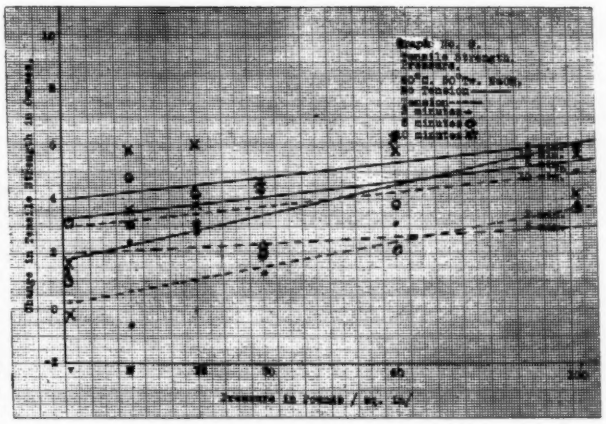
For the first half of the present year a total of 17,474 suggestions were made and 5,616 were adopted, as compared with 13,200 suggestions offered the first six months of 1929 and an adoption of 3,953 for which $49,586 was paid employees.—*General Electric Bulletin.*

Pressure Factor in Mercerization

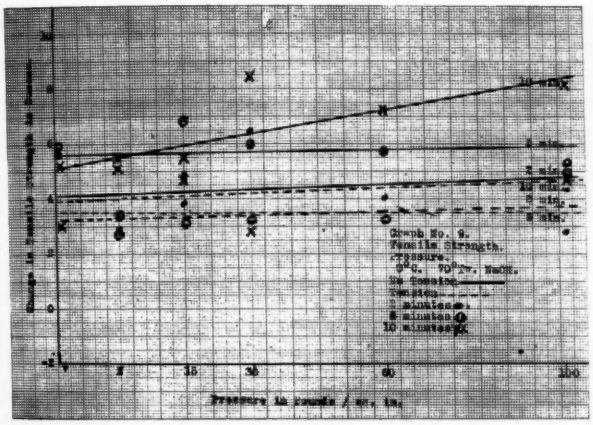
(*Continued from page* 580)



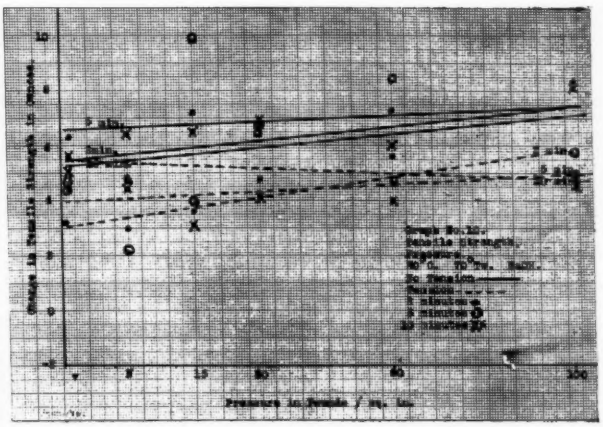
Graph No. 7
50° Tw. NaOH at 50° C.



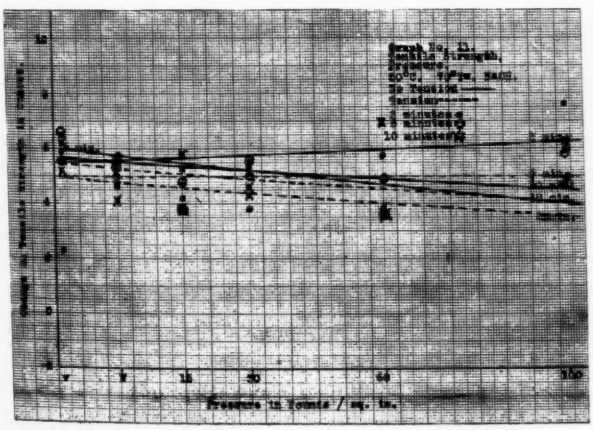
Graph No. 8
50° Tw. NaOH at 80° C.



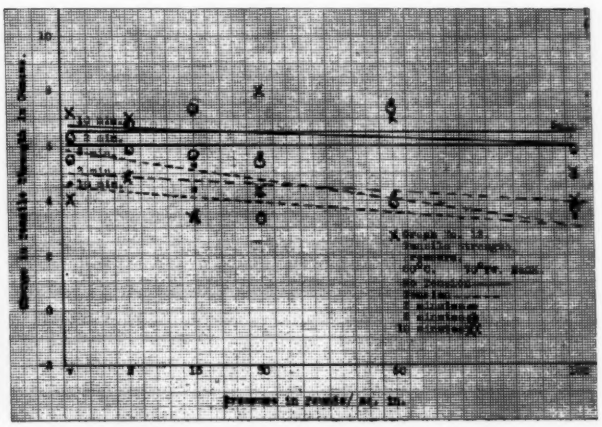
Graph No. 9
70° Tw. NaOH at 0° C.



Graph No. 10
70° Tw. NaOH at 30° C.



Graph No. 11
70° Tw. NaOH at 50° C.



Graph No. 12
70° Tw. NaOH at 80° C.

TABLE IX—70° Tw. NaOH at 0°C.

Series A No.	Pressure Lbs.	Time Min.	Stretch	Regain %	STRENGTH Treated oz.	STRENGTH Untreated oz.	STRENGTH Difference oz.	EXTENSIBILITY Treated %	EXTENSIBILITY Untreated %	EXTENSIBILITY Difference %	Shrinkage %
1a	–14.3	2	—	9.0	25.9	20.4	5.5	20.0	6.2	13.8	21.0
b	–14.3	5	—	6.4	26.5	20.7	5.8	21.6	6.9	14.7	19.5
c	–14.3	10	—	9.6	26.0	20.7	5.3	19.9	6.9	13.0	17.0
2a	–14.3	2	+	9.0	23.6	20.4	3.2	5.4	6.2	–0.8	....
b	–14.3	5	+	6.4	26.3	20.7	5.6	6.0	6.9	–0.9	....
c	–14.3	10	+	9.6	23.7	20.7	3.0	6.1	6.9	–0.8	....
1a	normal	2	—	9.0	23.3	20.4	2.9	19.0	6.2	12.8	21.5
b	N	5	—	6.4	26.2	20.7	5.5	19.9	6.9	13.0	24.0
c	N	10	—	9.6	25.8	20.7	5.1	21.4	6.9	14.5	22.0
2a	N	2	+	9.0	23.2	20.4	2.8	5.2	6.2	–1.0	....
b	N	5	+	6.4	23.4	20.7	2.7	6.1	6.9	–0.8	....
c	N	10	+	9.6	24.0	20.7	3.3	5.9	6.9	–1.0	....
1a	15	2	—	9.0	25.1	20.4	4.7	20.0	6.2	13.8	20.0
b	15	5	—	6.4	27.5	20.7	6.8	19.7	6.9	12.8	17.5
c	15	10	—	9.6	25.4	20.7	4.7	20.9	6.9	14.0	18.5
2a	15	2	+	9.0	24.2	20.4	3.8	5.7	6.2	–0.5	....
b	15	5	+	6.4	23.7	20.7	3.0	6.1	6.9	–0.8	....
c	15	10	+	9.6	26.2	20.7	5.5	6.3	6.9	–0.6	....
1a	30	2	—	9.0	26.8	20.4	6.4	21.1	6.2	14.9	21.0
b	30	5	—	6.4	26.3	20.7	5.6	20.8	6.9	13.9	20.5
c	30	10	—	9.6	29.1	20.7	8.4	19.7	6.9	12.8	18.5
2a	30	2	+	9.0	24.7	20.4	4.3	5.6	6.2	–0.6	....
b	30	5	+	6.4	23.5	20.7	2.8	5.9	6.9	–1.0	....
c	30	10	+	9.6	23.5	20.7	2.8	5.0	6.9	–1.9	....
1a	60	2	—	9.0	24.4	20.4	4.0	19.0	6.2	12.8	20.0
b	60	5	—	6.4	26.1	20.7	5.4	20.0	6.9	13.1	21.0
c	60	10	—	9.6	27.1	20.7	6.4	19.9	6.9	13.0	18.5
2a	60	2	+	9.0	23.9	20.4	3.5	5.7	6.2	–0.5	....
b	60	5	+	6.4	23.5	20.7	2.8	5.6	6.9	–1.3	....
c	60	10	+	9.6	26.4	20.7	5.7	6.1	6.9	–0.8	....
1a	100	2	—	9.0	24.7	20.4	4.3	18.9	6.2	12.7	....
b	100	5	—	6.4	25.6	20.7	4.9	19.0	6.9	12.1	....
c	100	10	—	9.6	28.8	20.7	8.1	20.7	6.9	13.8	....
1a	100	2	+	9.0	23.2	20.4	2.8	5.4	6.2	–0.8	....
b	100	5	+	6.4	25.3	20.7	4.6	5.7	6.9	–1.2	....
c	100	10	+	9.6	25.5	20.7	4.8	6.2	6.9	–0.7	....

LUSTER

1a: Very swollen.
2a: Luster ⅔ that of rayon.
1b: Less swollen than 1a.
2b: Same as 2a.
1c: Less swollen than 1b.
2c: Same as 2a.

Observations on Luster:—

(a) In all cases those mercerized under no tension possess no luster.

(b) In no-tension samples swelling is greatest at 0° C. and least at 80° C.

(c) After the first two minutes swelling becomes less as time increases.

(d) Luster increases with strength of solution up to 50° Tw.

(e) Those mercerized under tension at 50° Tw. and greater acquired a luster 2/3 that of rayon.

(f) The luster of those mercerized in solution at temperatures greater than 30° C. suffers greatly, until it is difficult to distinguish no-tension samples from tension samples when mercerized at 80° C.

Effects of Pressure on Tensile Strength—Graphs Nos. 1 to 4 show the effect of pressure on tensile strength when using 30° Tw. caustic solution. In this group the tensile strength increases with an increase of pressure at 30° and 50° C. At 50° C. using 30 pounds pressure for 5 minutes fairly good results are obtained, but better results are obtained at 30° C. using normal pressure for 10 minutes. At 0° C. and 80° C. pressure has no definite effect on tensile strength; at 0° C. the tendency is toward a decrease in tensile strength with an increase of pressure.

Graphs No. 5 to 8 show the effect of pressure on the tensile strength when using 50° Tw. caustic solution. In this group the tensile strength increases with increase in pressure at 0° C. and 80° C. At 80° C. using 60 to 100 pounds pressure for 2 minutes fairly good results are obtained, but better results are obtained at 0° C. using 15 to 30 pounds pressure for 10 minutes. At 30° C. and 50° C. pressure has no definite effect on the tensile strength.

Graphs No. 9 to 12 show the effect of pressure on the tensile strength when using 70° Tw. caustic solution. In this group the tensile strength increases with an increase

TABLE X—70° Tw. NaOH at 30° C.

Series B No.	Pressure Lbs.	Time Min.	Stretch	Regain %	STRENGTH Treated oz.	STRENGTH Untreated oz.	STRENGTH Difference oz.	EXTENSIBILITY Treated %	EXTENSIBILITY Untreated %	EXTENSIBILITY Difference %	Shrinkage %
1a	–14.3	2	—	9.6	27.1	20.7	6.4	18.3	6.9	11.4	17.5
b	–14.3	5	—	7.4	24.5	20.1	4.4	18.0	6.5	11.5	17.0
c	–14.3	10	—	7.3	25.3	19.7	5.6	20.6	6.4	14.2	17.5
2a	–14.3	2	+	9.6	23.9	20.7	3.2	5.6	6.9	–1.3	....
b	–14.3	5	+	7.4	24.7	20.1	4.6	5.2	6.5	–1.3	....
c	–14.3	10	+	7.3	24.7	19.7	5.0	5.6	6.4	–0.8	....
1a	normal	2	—	9.6	25.9	20.7	5.2	19.7	6.9	12.8	16.0
b	N	5	—	7.4	24.8	20.1	4.7	18.3	6.5	11.8	19.0
c	N	10	—	7.3	24.2	19.7	4.5	17.0	6.4	10.6	17.5
2a	N	2	+	9.6	23.7	20.7	3.0	5.7	6.9	–1.2	....
b	N	5	+	7.4	22.2	20.1	2.1	5.2	6.5	–1.3	....
c	N	10	+	7.3	26.1	19.7	6.4	5.5	6.4	–0.9	....
1a	15	2	—	9.6	27.9	20.7	7.2	18.1	6.9	11.2	16.0
b	15	5	—	7.4	29.9	20.1	9.8	18.4	6.5	11.9	16.0
c	15	10	—	7.3	26.2	19.7	6.5	18.5	6.4	12.1	21.5
2a	15	2	+	9.6	24.3	20.7	3.6	5.9	6.9	–1.0	....
b	15	5	+	7.4	24.0	20.1	3.9	5.7	6.5	–0.8	....
c	15	10	+	7.3	22.8	19.7	3.1	5.3	6.4	–1.1	....
1a	30	2	—	9.6	25.0	20.7	4.3	14.7	6.9	7.8	13.5
b	30	5	—	7.4	26.8	20.1	6.7	18.3	6.5	11.8	16.2
c	30	10	—	7.3	26.6	19.7	6.9	18.7	6.4	12.3	20.0
2a	30	2	+	9.6	25.5	20.7	4.8	6.1	6.9	–0.8	....
b	30	5	+	7.4	26.4	20.1	6.3	5.9	6.5	–0.6	....
c	30	10	+	7.3	23.8	19.7	4.1	5.7	6.4	–0.7	....
1a	60	2	—	9.6	27.9	20.7	7.2	19.9	6.9	13.0	17.0
b	60	5	—	7.4	29.4	20.1	9.3	18.9	6.5	12.4	11.0
c	60	10	—	7.3	23.6	19.7	3.9	18.1	6.4	11.7	16.5
2a	60	2	+	9.6	26.4	20.7	5.7	6.1	6.9	–0.8	....
b	60	5	+	7.4	24.7	20.1	4.6	5.7	6.5	–0.8	....
c	60	10	+	7.3	25.7	19.7	6.0	5.7	6.4	–0.7	....
1a	100	2	—	9.6	28.8	20.7	8.1	20.7	6.9	13.8	16.0
b	100	5	—	7.4	25.8	20.1	5.7	19.0	6.5	12.5	20.0
c	100	10	—	7.3	28.1	19.7	8.4	18.4	6.4	12.0	18.0
1a	100	2	+	9.6	25.5	20.7	4.8	6.2	6.9	–0.7	....
b	100	5	+	7.4	25.0	20.1	4.9	6.0	6.5	–0.5	....
c	100	10	+	7.3	24.2	19.7	4.5	5.4	6.4	–1.0	....

LUSTER

1a: Same as Series A 1a.
2a: Same as Series A 2a.
1b: Same as Series A 1a.
2b: Same as Series A 2a.
1c: Same as Series A 1a.
2c: Same as Series A 2a.

in pressure at 0° C. and 30° C. At 0° C. using 15 pounds pressure for 10 minutes good results are obtained, but better results are obtained at 30° C. using 60 pounds pressure for 2 to 5 minutes. However, this condition is not so good as that used at 0° C. with 50° Tw. At 50° C. pressure has no definite effect on the tensile strength, but at 80° C. there is a slight increase in tensile strength with an increase of pressure in those treated under no tension, while those treated under tension show a decrease in tensile strength with an increase in pressure.

In all cases those treated under no tension having a greater tensile strength than those treated under tension are less affected by pressure than those treated under tension.

Effects of Pressure on Extensibility—Pressure has no marked effect upon extensibility, since the lines drawn through the points show a uniform extensibility throughout with an increase in pressure.

Effects of Pressure on Shrinkage and Dye Affinity—Pressure has no effect upon the degree of shrinkage and dye affinity.

Summary

It can be readily seen from the three groups of graphs on pressure that with an increase in solution strength there has to be an increase in pressure with an increase of temperature and a decrease in time of immersion to obtain identical results. Conversely, with a decrease in solution strength there has to be a decrease in pressure with a decrease in temperature and an increase in time of immersion to obtain identical results. In other words, equilibrium between the cellulose and caustic solution has been disturbed by the introduction of pressure and hence temperature must be adjusted in order to aid in satisfying the equilibrium.

Solutions very much stronger than 50° Tw. dissolve too nearly all the outer cuticle from the cellulose, leaving it in a weakened condition, while solutions weaker than 50° Tw. do not attack the cellulose enough to get the desired effect. However, with 30° Tw. solution at 0° to 50° C., luster is as good as the best obtained in mercerizing with 62.5 per cent sulfuric acid."

TABLE XI—70° Tw. NaOH at 50° C.

Series C No.	Pressure Lbs.	Time Min.	Stretch	Regain %	STRENGTH Treated oz.	STRENGTH Untreated oz.	STRENGTH Difference oz.	EXTENSIBILITY Treated %	EXTENSIBILITY Untreated %	EXTENSIBILITY Difference %	Shrinkage %
1a	−14.3	2	—	9.0	25.9	19.7	6.2	19.0	6.4	12.6	16.5
b	−14.3	5	—	7.3	26.6	20.1	6.5	16.8	6.8	10.0	16.5
c	−14.3	10	—	9.0	26.2	20.1	6.1	18.2	6.8	11.4	17.0
2a	−14.3	2	+	9.0	25.6	19.7	5.9	5.9	6.4	−0.5	....
b	−14.3	5	+	7.3	25.3	20.1	5.2	5.8	6.8	−1.0	....
c	−14.3	10	+	9.0	25.6	20.1	5.5	5.7	6.8	−1.1	....
1a	normal	2	—	9.0	24.5	19.7	4.8	18.1	6.4	11.7	19.0
b	N	5	—	7.3	25.6	20.1	5.5	18.3	6.8	11.5	19.0
c	N	10	—	9.0	25.2	20.1	5.1	18.6	6.8	11.8	18.5
2a	N	2	+	9.0	23.8	19.7	4.1	6.7	6.4	−0.7	....
b	N	5	+	7.3	24.2	20.1	4.1	5.5	6.8	−1.3	....
c	N	10	+	9.0	25.7	20.1	5.6	5.8	6.8	−1.0	....
1a	15	2	—	9.0	25.0	19.7	5.3	16.4	6.4	10.0	11.0
b	15	5	—	7.3	24.8	20.1	4.7	17.5	6.8	10.7	16.0
c	15	10	—	9.0	25.9	20.1	5.8	19.0	6.8	12.2	17.5
2a	15	2	+	9.0	23.9	19.7	4.2	5.6	6.4	−0.8	....
b	15	5	+	7.3	23.9	20.1	3.8	5.4	6.8	−1.4	....
c	15	10	+	9.0	23.9	20.1	3.8	5.8	6.8	−1.0	....
1a	30	2	—	9.0	25.1	19.7	5.4	17.4	6.4	11.0	21.5
b	30	5	—	7.3	25.5	20.1	5.4	16.5	6.8	9.7	17.0
c	30	10	—	9.0	24.5	20.1	4.4	17.4	6.8	10.6	20.0
2a	30	2	+	9.0	23.5	19.7	3.8	5.5	6.4	−0.9	....
b	30	5	+	7.3	25.6	20.1	5.5	5.7	6.8	−1.1	....
c	30	10	+	9.0	25.1	20.1	5.0	5.7	6.8	−1.1	....
1a	60	2	—	9.0	25.4	19.7	5.7	16.9	6.4	10.5	22.5
b	60	5	—	7.3	24.2	19.7	4.5	19.8	6.4	13.4	19.5
c	60	10	—	9.0	27.1	20.1	7.0	16.3	6.8	9.5	17.0
2a	60	2	+	9.0	23.6	19.7	3.9	5.2	6.4	−1.2	....
b	60	5	+	7.3	24.5	19.7	4.8	5.7	6.4	−1.7	....
c	60	10	+	9.0	23.7	20.1	3.6	5.5	6.8	−1.3	....
1a	100	2	—	9.0	27.3	19.7	7.6	17.0	6.4	10.6	19.5
b	100	5	—	7.3	25.6	19.7	5.9	18.5	6.4	12.1	19.5
c	100	10	—	9.0	25.0	20.1	4.9	18.2	6.8	11.4	19.0
1a	100	2	+	9.0	24.5	19.7	4.8	5.5	6.4	−0.9	....
b	100	5	+	7.3	24.5	19.7	4.8	5.7	6.4	−0.7	....
c	100	10	+	9.0	26.4	20.1	6.3	6.0	6.8	−0.8	....

LUSTER

No. 1a: Less swollen than Series B 1a.
2a: Same as Series A 2a.
1b: Same as 1a.
2b: Same as Series A 2a.
1c: Same as 1a.
2c: Same as Series A 2a.

All graphs show a great change at temperatures between 30° and 50° C., the cause of which has never been determined; nor has a satisfactory theory been given to explain it. Hubner and Pope[6] maintain that a change in the fiber make-up takes place in the region of these temperatures. This also shows up in graphs No. 6 and 7, where pressure has no definite effects at 30° and 50° C. using the ideal solution. Higher temperatures than 30° C. attack the fiber too violently, weakening it as evidenced by the way yarns break with a snap and are less elastic.

The results of this investigation indicate that:

1. With an increase in pressure there is an increase in tensile strength at temperatures between 0° and 50° C.

2. Pressure has no marked effect upon extensibility.

3. Pressure has no marked effect upon the degree of shrinkage and dye affinity.

4. With an increase in time of immersion there is an increase in tensile strength within reasonable limits, beyond which there is a weakening effect.

5. With an increase in time of immersion there is very little increase in extensibility on yarns under no tension, while there is a decrease in extensibility with those under tension.

6. With an increase in time of immersion there is an increase in shrinkage.

7. Time of immersion has no effect upon dye affinity.

8. With an increase in time of immersion there is an increase in swelling up to 2 minutes.

9. With an increase in temperature there is a decrease in tensile strength.

10. With an increase in temperature there is a decrease in extensibility.

11. With an increase in temperature there is a decrease in shrinkage.

12. With an increase in temperature there is a decrease in luster and swelling of fiber.

13. With an increase in strength of solution there is a uniform increase in dye affinity, no-tension samples possessing a darker shade than tension samples.

TABLE XII—70° Tw. NaOH at 80° C.

Series D No.	Pressure Lbs.	Time Min.	Stretch	Regain %	STRENGTH Treated oz.	STRENGTH Untreated oz.	STRENGTH Difference oz.	EXTENSIBILITY Treated %	EXTENSIBILITY Untreated %	EXTENSIBILITY Difference %	Shrinkage %
1a	−14.3	2	—	9.0	27.3	20.1	7.2	15.3	6.8	8.5	12.0
b	−14.3	5	—	9.0	26.4	20.1	6.3	16.3	6.8	9.5	14.0
c	−14.3	10	—	9.0	23.9	20.1	3.8	13.2	6.8	6.4	11.0
2a	−14.3	2	+	9.0	24.7	20.1	4.6	5.3	6.8	−1.5	....
b	−14.3	5	+	9.0	25.5	20.1	5.4	5.4	6.8	−1.4	....
c	−14.3	10	+	9.0	24.1	20.1	4.0	5.9	6.8	−0.9	....
1a	normal	2	—	9.0	24.5	20.1	4.4	15.1	6.8	8.3	17.0
b	N	5	—	9.0	27.3	20.1	7.2	16.1	6.8	9.3	16.0
c	N	10	—	9.0	25.4	20.1	5.3	17.1	6.8	10.3	15.0
2a	N	2	+	9.0	24.8	20.1	4.7	5.2	6.8	−1.6	....
b	N	5	+	9.0	25.6	20.1	5.5	5.1	6.8	−1.7	....
c	N	10	+	9.0	23.5	20.1	3.4	5.6	6.8	−1.2	....
1a	15	2	—	9.0	24.5	20.1	4.4	15.1	6.8	8.3	16.0
b	15	5	—	9.0	25.6	20.1	5.5	16.3	6.8	9.5	16.0
c	15	10	—	9.0	28.1	20.1	8.0	17.3	6.8	10.5	17.0
2a	15	2	+	9.0	24.5	20.1	4.4	5.1	6.8	−1.7	....
b	15	5	+	9.0	23.6	20.1	3.5	5.3	6.8	−1.5	....
c	15	10	+	9.0	24.6	20.1	4.5	5.6	6.8	−1.2	....
1a	30	2	—	9.0	27.7	20.1	7.6	17.0	6.8	10.2	13.0
b	30	5	—	9.0	27.6	20.1	7.5	14.9	6.8	8.1	17.0
c	30	10	—	9.0	27.2	20.1	7.1	16.1	6.8	9.3	17.0
2a	30	2	+	9.0	24.8	20.1	4.7	5.2	6.8	−1.6	....
b	30	5	+	9.0	23.9	20.1	3.8	5.2	6.8	−1.6	....
c	30	10	+	9.0	22.8	20.1	2.7	5.2	6.8	−1.6	....
1a	60	2	—	9.0	25.0	20.1	4.9	16.5	6.8	9.7	16.0
b	60	5	—	9.0	25.8	20.1	5.7	16.0	6.8	9.2	16.5
c	60	10	—	9.0	25.1	20.1	5.0	14.1	6.8	7.3	14.5
2a	60	2	+	9.0	23.5	20.1	3.4	5.3	6.8	−1.5	....
b	60	5	+	9.0	24.0	20.1	3.9	5.2	6.8	−1.6	....
c	60	10	+	9.0	24.1	20.1	4.0	5.6	6.8	−1.2	....
1a	100	2	—	9.0	27.0	20.1	6.9	17.0	6.8	10.2	17.0
b	100	5	—	9.0	27.0	20.1	6.9	15.2	6.8	8.4	16.0
c	100	10	—	9.0	26.5	20.1	6.4	16.9	6.8	10.1	16.0
1a	100	2	+	9.0	25.1	20.1	5.0	5.3	6.8	−1.5	....
b	100	5	+	9.0	25.9	20.1	5.8	5.7	6.8	−1.1	....
c	100	10	+	9.0	25.0	20.1	4.0	5.5	6.8	−1.3	....

LUSTER

No. 1a: Very white, little swollen.
2a: Very lustrous.
1b: Less swollen than 1a, very white, little lustrous.
2b: Same as 2a.
1c: Less swollen than 1b, white, slight harsh feeling, more luster than 1b.
2c: Same as 2a.

14. With an increase in strength of solution there is an increase in shrinkage.

15. With an increase in strength of solution there is an increase in tensile strength within reasonable limits, beyond which it has a weakening effect.

16. Luster increases with an increase in strength of solution within reasonable limits, beyond which there is no increase.

17. Yarns treated loosely possess no luster.

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Carbic Color & Chemical Co., Inc., are distributing a new pamphlet issued by Durand & Huguenin, illustrating Indigosol Brown IRRD and Indigosol Scarlet IB dyed on wool.

Both colors are water soluble Leuco compounds of the Indanthrene series, and dyeings on wool are said to possess the extremely good fastness to light that is one of the outstanding characteristics of colors of this type. They are also claimed to have fastness to milling, washing, perspiration, salt water, etc.

Rapid Methods for the Determination of Hydrosulphites

When sodium hydrosulphite is treated with an oxidizing agent it can be completely converted to sodium sulphate. But such a complete transformation does not give its value as a reducing agent, as this depends solely on its conversion to sodium sulphite, under the conditions in which it is usually employed, according to the equation—

$$Na_2S_2O_4 + O + H_2O = 2NaHSO_3.$$

Oxidation to this first stage only may conveniently be effected by the action of a solution of potassium ferricyanide or ammonia iron alum. Potassium ferricyanide is reduced to the ferrocyanide—

$$Na_2S_2O_4 + 2K_3Fe(CN)_6 = 2SO_2 + 2K_3NaFe(CN)_6.$$

A small quantity of ferrous sulphate is added before beginning the titration, so that the colorless ferrous ferrocyanide first formed shows by its conversion to prussian blue the instant when the ferricyanide has been added in excess. If necessary, a little acetic acid is added to ensure that the liquid shall be acid.

Another convenient substance for the titration of hydrosulphites is ferric sulphate, partly transformed into the red ferric sulphocyanide by the addition of ammonium sulphocyanide. When this red solution is added to a solution of a hydrosulphite the red color is instantaneously discharged as long as any hydrosulphite is present. When the titration mixture retains a trace of red color, the estimation is finished. The Chemische Fabrik Pyrgos, who have recently introduced their "Sapometer" for the rapid determination of the percentage of fatty acids in soaps, have now brought out an equally simple piece of apparatus for the easy estimation of hydrosulphite preparations either in powder or in liquid form.

Their "Hydrosulfometer" consists of a glass cylinder and a quart bottle containing a special measuring solution. The cylinder is fitted with a glass stopper and graduated from 0 per cent to 115 per cent in values of 5 per cent. As subdivisions were omitted, end points between marked values must be judged. Below the zero mark is room for the specimen to be placed.

It is immaterial which hydrosulphite preparations are to be tested — i.e., hydrosulphite, Rongalite, Lykopon, Stripine, Formapon, Discolite, Candit V, etc.; the reducing value of any one is compared to sodium hydrosulphite $Na_2S_2O_4$. For example, a hydrosulphite preparation analyses 80 per cent with the "Hydrosulfometer." This means the specimen tested has the reducing power of 80 per cent pure, dry sodium hydrosulphite content.

Undecomposed and pure Rongalite tests, by this method, 113 per cent, and the graduation of the cylinder is therefore extended to 115 per cent.

The method uses the reduction of trivalent to divalent iron by these agents, whereby ferric sulphocyanate acts as indicator. The deep-red solution changes to a colorless one as soon as all Fe^{III} is reduced to Fe^{II}.

Rup ("Chem. Ztg.," 1925, page 42) used this method for hydrosulphite determinations, but worked in a nitrogen or illuminating gas atmosphere which, for obvious reasons, by this practical method is avoided. To analyze one proceeds as follows:—

(A) For Preparations in Powder or Lumps.—Drop ½ cc. of acetone in the "Hydrosulfometer." Acetone has a stabilizing effect on hydrosulphites, and tests are more accurate, although the use of acetone is not a necessity. 1 grm. of the substance is weighed out and put in the cylinder, then distilled or freshly boiled water (air free) is added, up to the 0 mark. Stir with a glass rod, do not shake to dissolve the powder or small granules. Now add in small portions the measuring solution, as long as discoloration takes place instantly. Towards the end the change is not as rapid, and drop by drop additions are made, and the cylinder closed and shaken. The mark reached by the red remaining liquid indicates the percentage of pure, dry sodium hydrosulphite.

The change from red to colorless takes place instantly with Rongalite or Candit V. Hydrosulphite gives an intermediary yellow color, which changes to a colorless solution only after the greater part of the necessary measuring solution is added. By Rongalite and its competitive formaldehyde sulphoxylate compounds the color change is very reluctant towards the end, and one must therefore allow a few minutes before reading the definite result.

(B) Products in Paste Form.—These are weighed out on a filter paper, which is dropped in the cylinder, and further procedure as in A.

(C) Solutions of Hydrosulphites.—These need no weighing. The liquid in question is poured in the apparatus up to the 0 mark. Do as in A.

The readings are ten times higher, and one must therefore shift the decimal point one place to the left. This also necessitates diluting solutions stronger than 11.5 per cent to twice, triple, quadruple, etc., volume, and the resultant findings are multiplied by 2, 3, 4, etc.

Control analyses with Heermann's indigo method gave comparable results and established the practicability of the "Hydrosulfometer"— i.e., a commercial product analyzed by the indigo method proved 93 per cent, the "Hydrosulfometer" reading 90 per cent; a 5 per cent formaldehyde sulphoxylate solution with a theoretical hydrosulphite content of 5.6 per cent read 5.2 per cent and 5.5 per cent respectively.

This accuracy is sufficient for technical purposes, and the easy and rapid testing afforded by this apparatus should make same a standard control equipment in laboratories or dyehouses using hydrosulphite preparations.

Should the "Hydrosulfometer" not be available, the titration of hydrosulphites may be just as easily carried out with the apparatus at hand in every dyehouse laboratory. The standard measuring solution is prepared by making up 55.4 grms. of iron ammonia alum and 5 grms. of ammonium sulphocyanide to 1 liter. The gram of hydrosulphite is dissolved with as little agitation as possible in a flask of about 250 c.c. capacity. The measuring solution is filled into a 100 c.c. cylinder, from which it is slowly added to the hydrosulphite solution as long as the red color keeps on being discharged. The percentage of the sample being analyzed will then be given by the volume of measuring solution consumed. In place of the iron ammonia alum, potassium ferricyanide at the rate of 75.8 grms. per liter may be used. In this case, before beginning the titration, a few drops of ferrous sulphate (copperas) solution are added to the hydrosulphite in the flask, together with sufficient dilute acetic acid to turn blue litmus paper red. The end of the reaction will be indicated by the appearance of the deeply colored prussian blue.—*Textile Manufacturer.*

R & H Board Changes

At a meeting of the Board of Directors of The Roessler & Hasslacher Chemical Company held Monday, August 25, 1930, Dr. Edward A. Rykenboer was elected a member of the Board, replacing Mr. George F. Hasslacher who resigned as Director and Assistant Secretary on July 28th.

Dr. Rykenboer is 41 years of age, a man of fine personality, who possesses exceptional executive ability. He is a graduate of the University of Rochester, 1912, and took his Ph.D. degree at the University of Michigan where he taught, after his graduation, until 1917. In the same year he joined the Roessler & Hasslacher forces at Niagara Falls as a research chemist and from that position became Superintendent of Production and is now General Superintendent of the Niagara Falls plant of The Roessler & Hasslacher Chemical Company.

At the same meeting Mr. J. Carlisle Swaim was elected Assistant Secretary.

Mr. Swaim is 41 years of age, holding the A.B. 1911 and M.A. 1913 degrees from Vanderbilt University, Nashville, Tennessee, also LL.B. 1915 from Columbia University Law School, where he also did a year's post graduate work in law. After leaving the Army he became associated with the law firm of Merrill, Rogers, Gifford & Woody where he remained in the general practice of law until, as Resident Counsel, he became associated with The Roessler & Hasslacher Chemical Company in November, 1928.

New Position for Dr. Walter M. Scott

Dr. Walter M. Scott has recently joined the chemical research and development organization of Dr. Gustavus J. Esselen at 73 Newbury Street, Boston. Dr. Scott will devote his attention particularly to problems in the field of textile chemistry and technology, including the proper formulation and use of dyes and finishes, a subject in which he is a recognized authority.

Dr. Scott received a thorough grounding in the principles and practice of organic chemistry at Yale University where he was awarded the Degree of Doctor of Philosophy in 1915. After leaving college, he organized the technical department of Cheney Brothers, silk manufacturers, and he served as its director for over ten years. Subsequently, he was technical advisor to the dyestuff sales department of the National Aniline and Chemical Company, and later became service director of the Munsell Color Company, an organization specializing in color measurement and specification.

Dr. Scott is a charter member of the American Association of Textile Chemists and Colorists, and has been particularly active as chairman of two of its important research committees. He has published numerous articles relating to the industrial application of the principles of dye and textile chemistry.

General Dyestuff Release

General Dyestuff Corporation has recently brought out two new shade cards. "Indanthren Dyeings on Viscose" which includes dyeings of all the Indanthren colors, as well as a suitable selection of modern compound shades of the best levelling colors. It also includes a fastness table based on the tests prescribed and issued in 1928 by the German Fastness Committee.

In the card "Brilliant Shades on Woolen Yarn Produced with Brilliant Sulpho Flavine FF" given out by the General Dyestuff Corporation, this new acid dyeing yellow of exceptional brilliancy is shown straight and in combination with Sulpho Rhodamine B and G for producing bright oranges and scarlets, and with Brilliant Acid Blue FF for bright green shades.

ALBERT J. FARMER

It is with the deepest regret that we announce the sudden death of Albert J. Farmer, who for years has been one of the most prominent men in the chemical industry. He was president of the Pharma-Chemical Company, and a member of the Board of Governors and treasurer of the Synthetic Organic Chemical Mfrs. Assn. Death occurred Saturday, September 6th, a few hours after an emergency operation. It may be recalled that Mr. Farmer lost his wife very suddenly only ten months ago.

Technical Notes from Foreign Sources

Saponification of Fats in the Cold, with Catalysts

D. Sabrammy and J. Itzkowitsch — Maslobojno-Shirowoje Djelo, 1928, *Heft* 10, *S.* 18 (*from Monatsch. f. Textil. Ind.* 45, 78 (1930).—The authors have repeated the work of Roshdestwensky on the same subject, and have found that the same favorable results of R. can be obtained with considerably less catalyst. E.g.,R., in working with cottonseed oil and 1% of alpha-naphthol, observed a maximum temperature of 28° C., after 40 minutes; the authors reached the same temperature with the use of 0.5% of alpha-naphthol after 60 minutes. One per cent of beta-naphthol gave a maximum of 27° C. after 50 minutes; the authors attained the same result with 0.2% of beta-naphthol. From their own observations, compared with those of R., the amount of oil worked up has some effect upon the time-temperature figure. S. and I. also made some experiments involving pretreatment of the oil with sulphuric acid, under the assumption that the sulpho-compounds formed would promote the formation of an effective emulsion and so hasten the process of saponification, as well as increase the maximum temperature (an index of the vigor of the reaction). But there was no noticeable difference to be observed. Crude cottonseed oil saponifies more rapidly than does the refined oil, evidently because of the presence in it of free fatty acids, so that the difference is more apparent than real. Alpha-naphthol cannot well be used as a catalyst in practise, for the soap obtained by its use is colored dark green. Much the same result is to be noticed when beta-naphthol is used.

The authors have made large-scale trials with the soaps produced in the cold way as above, and have found that these soaps fulfill all requirements, and are more economical to use than the boiled soaps, possibly due to the greater hardness of the soaps produced by the cold process. Large-scale manufacture shows that 7500 kg. can easily be produced per day. The glycerol, of course, remains in the soap, and its loss partly offsets the gain from saving in fuel; but the process is at least more economical than the boil process.

A large table of data derived from the experimental work is added.

Azo Dyestuffs for Viscose, etc

British Patent No. 270,446—British Dyestuffs Corp., Ltd.—The procedure consists essentially in the coupling of various types of diazotized amines to such derivatives of a dinaphthylamine as 8-8'-dihydroxy-2-2'-dinaphthylamine-6-6'-disulphonic acid or the 3-6-3'-6'-tetrasulphonic acid, the coupling to such a passive component naturally taking place in alkaline reaction, soda being usually employed. Thus, m-aminobenzoic acid is diazotized and so coupled; the product dyes viscose brown. Alpha-naphthylamine gives a violet, p-chlor-aniline a reddish-brown, m-xylidine a violet dyestuff. Likewise, the diazo-compound of a nitro- or acetamino-base can be employed, and the resulting dyestuff reduced as to the nitro group or hydrolyzed as to the acetamino-group, in either case a free amino-group being generated in the dyestuff. Such products can obviously be diazotized and developed upon the fiber with other suitable passive components, e.g., if p-amino-acetanilide is diazotized and coupled to the dinaphthylamine derivative, and the acetyl group split off by hydrolysis in a manner already well known in practise, a product is obtained which dyes viscose a violet-black; the viscose dyeing so obtained, if diazotized and developed with beta-naphthol, passes to a handsome blue.

In the above, it is implied that for each molecule of the dinaphthylamine derivative two molecules of the diazotized base are employed, symmetrical disazo dyestuffs being so produced. Naturally, by selection of the proper conditions, a molecule each of two different diazotized bases can be employed, so producing an asymmetrical disazo dyestuff. An example of this procedure employs one molecule each of diazotized p-nitro-aniline-o-sulphonic acid and alpha-naphthylamine to one molecule of the tetrasulphonic acid derivative first mentioned. This product dyes viscose violet.

Dyeings with these products are carried out as usual with acid dyestuffs. The use of the heavy dinaphthylamine nucleus appears not only to deepen the shade of the dyestuff as compared with homologous products containing a lighter nucleus, but also to increase the light-fastness of the dyestuffs. This heavier nucleus imparts a definite affinity for cellulose.

Immunized Cotton

J. I. Marsh—Ind. Chem. 4, 57 (1929).—A general discussion of the above textile material in its practical aspects.

Cotton and wool mixtures are often employed in order to obtain certain effects, simple white lines, etc., by dyeing the goods with a dyestuff which will go upon one and not upon the other component, but the cost of the wool element, in case of some weaves, and the not strikingly attractive appearance of the goods in comparison with special weaves, rather limit such unions to particular purposes. But a pure cotton weave with definite areas or lines or patterns which remain white when the fabric as a whole is dyed in a simple way (i.e., without resorting to special

methods or special dyestuffs) is something of deservedly great interest. Of the three possible methods of immunizing cotton: (a) coating the yarn with a resistant material, (b) impregnating the yarn with a resistant substance, and (c) altering the chemical nature and so the affinity for dyestuffs of the cotton, the third method is the one usually understood by the term "immunizing."

There is still comparatively little information to be found, in even comprehensive reference works, regarding the chemical nature and reactions of cellulose, although it has for some time been evident that cellulose is a very reactive substance, instead of a complex, rather inert material. Cross and Bevan have perhaps carried out and published most work in this direction, though their results are, for the most part, scattered widely through the different journals. Practically, however, the subject of immunized cotton as generally understood is rather a simple matter; the cotton is converted into an ester, partly or wholly so, by treatment with alkali and the chloride of an aromatic sulphonic acid.

The treatment of the product requires an understanding of its peculiarities. Singeing of the woven goods containing it is best done with the gas flame rather than with the hot-plate, for the material carbonizes rather easily, much more so than does cotton. Kier-boiling does no harm if carried out with dilute sodium carbonate, but hot and strong carbonate, especially when used under pressure, will damage the fiber. Bleaching, etc., is carried out as usual. Cold acids or alkalies are without effect upon the material, which is much more stable toward alkali than the acetates of cellulose. This was to be expected, in view of the much greater inertness of sulphonic esters in general. The material meets strong competition from the acetate-silks, but has some valuable properties of its own, useful along certain lines. It may claim attention also as being a step in the production of amidated cotton, if this latter fiber ultimately proves to be of value.

Lilienfeld Silk

Dr. L. Lilienfeld—Kunst-Seide 12, 128 (1930).—A somewhat polemical reply by the inventor of the process to an article by Dr. Roos in a recent issue of Kunst-Seide, in which R. questioned the value of the Lilienfeld process and product. As L. takes up the whole question very fully, a good deal of information regarding the process is incidentally to be picked out of the paper.

Dyeing of Acetate-Silk

H. Brandenburger—Kunst-Seide 12, 140 (1930).—Another paper by the well-known authority upon this topic; in this case consisting largely of tables, with a little discussion. Some idea of the scope of the paper may be given by the titles of the tables: Table 54, constants of the water soluble acetate-silk dyestuffs of the Fabrik Gebr. Seitz, Frankfort; Table 55, the same for similar products of the I. B.; Table 56, the same for similar products of Geigy, Table 57, constants of the disperse-dyestuffs for acetate-silk dyeing, of the I. G.; Table 58; the same for the like products of the Gesellschaft f. Chem. Ind. in Basle; Table 59, the same for products of the British Dyestuffs Corp., Ltd.; Table 60, the constants for the Ionamines of the British Dyestuffs Corp., Ltd., and Table 61, the constants for various Azols, Cellite Azols, Azonines, and Acedronols.

Dyeing and Printing of Cellulose Esters

German Patent No. 436,818 (*addition to G. P. No.* 420,017)—*I. G. Farben-Ind. A. G.*—Beside the sulphaminic acids of the original patent, the water-soluble sulphaminic acids (or their salts) of colored amino-compounds, especially those of amino-anthraquinones, are suitable for dyeing of cellulose esters. For example, the sodium salt of the sulphaminic acid of 1-4-diamino-anthraquinone gives a fine red-violet upon acetate-silk, that of 1-5 diamino-4-8-dihydroxy-anthraquinone gives a fine reddish-blue; that of 1-amino-4-methoxy-anthraquinone gives a brilliant bluish-red.

Orange Vat Dyestuffs

German Patent No. 458,598—*L. Cassella and Co.*—The products are halogen derivatives of anthanthrone. These, when vigorously halogenated, as with bromine at 270°-280°C. (under pressure), give brownish-red dyestuffs which are of very little value. The present procedure employs a milder sort of halogenation, the anthanthrone being suspended or dissolved in a suitable liquid medium, and halogen, or a substance capable of liberating halogen under the conditions chosen, passed in or gradually added. For example, a solution-suspension of one part of anthanthrone in 30 parts of trichlorbenzene is heated at 150°C., and chlorine passed in until the color of the mixture passes over from yellow to orange to reddish-orange as the chlorine is absorbed. When the color no longer changes toward red, the mixture is cooled, the product filtered off, washed with trichlorbenzene, then with alcohol. The dry product forms an orange-red powder, soluble in sulphuric acid with a pure green color. Its vat is violet. Cotton dyed in the vat is dyed of the same color, and oxidation or soaping developes the color to a bright, fast, yellowish-orange. The bromine derivative is similar. Several other examples are given. The products are all rather similar in properties.

Vat Dyestuffs of Indigoid Type

German Patent No. 455,280—*Gesellsch. f. Chem. Ind. in Basle*—The first step in this group is the condensation of alpha-thionaphthol with the halogen substitution products of alpha- and beta-thionaphthol, through reaction with oxalyl chloride. The naphthothiofurane-diones so prepared are then condensed with compounds which contain cyclic methylene groups capable of reaction. The dyestuffs so formed are either further halogenated or acidylated. The nine examples given cover a wide range of tones, and a table gives some characteristics of the products.

Columbia Cotton Goods Course Opens

Columbia University of New York, University Extension, will again open its comprehensive evening course, consisting of 30 lectures in the manufacture and finishing of cotton yarns and goods. The course is under the supervision of H. R. Mauersberger, who has directed it for the last four years.

The lectures are held every Friday evening, beginning September 26th, 1930, at 7:30 P. M., in Room 302, Mines Building, on the University Campus. The course is open to men and women alike, and the lectures are sufficiently non-technical for any layman to follow them. The lectures are illustrated by moving pictures, actual samples, and trips to nearby plants.

Registration for the course begins September 17th at the Registrar's office, Room 315, University Hall.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED

Salesman, 35 years of age, 15 years' experience, dyestuffs and allied specialties. Willing to start at small salary for probationary period. Address: Classified Box No. 634, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED

Dyestuff Salesman with many years of Sales and Laboratory experience is desirous of a suitable position with manufacturing concern. Advertiser has an extensive personal connection in various States and can give first-class references. Address: Classified Box No. 608, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED

As general foreman of inspection, put-up packing and shipping departments. Formerly connected with large finishing plant now liquidated. Thoroughly conversant with all grades of rayon and cotton piece goods. Best references, will locate anywhere; available immediately. Address: Classified Box No. 630, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED

Hosiery Dyer—twenty-nine, married, ten years' experience as laboratory and mill dyer and chemist on fancy hose and yarn, all combinations of fibers. Middle West desired, but not necessary. Address: Classified Box No. 631, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED

Dyestuff manufacturer has opening for experienced man in color matching, standardizing and testing all classes of dyestuffs on various textile fibers. Give full information regarding training, experience, salary expected, etc. Address: Classified Box No. 633, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED

Reliable manufacturer of Textile Soaps, Oils, Sizings, and Finishings for Cotton, Rayon, Silk and Wool, has opening for Salesman covering the Southern Territory, Pennsylvania, and New England. Only man with excellent sales connections need apply. Address: Classified Box No. 632, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED

Young man for laboratory work in cotton piece goods dyeing and finishing plant in South Carolina. Must have some knowledge of chemistry and dyeing. State experience and salary expected. Address: Classified Box No. 627, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

CHEMIST

Eight years' experience as research and manufacturing chemist, specializing in azo dyestuffs, sulphonated oils and varnish driers. Preferably in or around New York. Excellent references. Address: Classified Box No. 628, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

SPECIALIST ON SILK SOAKING OIL WANTED

New Jersey and Pennsylvania territory. An opportunity to become connected in a sales capacity with a sound, aggressive organization, second to none in resources and manufacturing facilities. Candidates must show successful selling record in this field. stating experience and whether now employed. Salary open. Replies will be held in strictest confidence. Our organization fully cognizant of this advertisement. Address: Classified Box No. 629, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.